The Electrical Industry's Weekly Magazine

July 9, 1956

Electrical World

Price 35 Cents

A McGraw-Hill Publication

Extra High Voltage:

Today's Best Transmission Investment

...Page 81

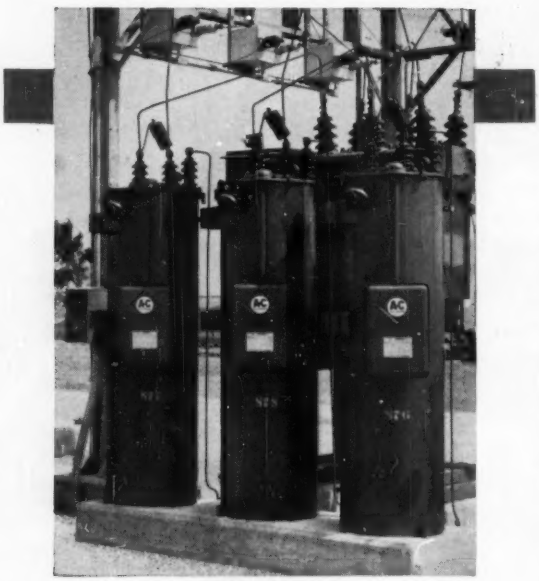
HEATING AND COOLING ELECTRICALLY

...Page 124

One operator writes this about Allis-Chalmers field help:

"When A-C people work on a regulator, they show up *with* the parts they might need, open the regulator once, service it, and it goes back on the line without delay."

ALLIS-CHALMERS
Originators of
5/8% Step
Voltage Regulators



FOR EITHER substation or feeder regulation, A-C distribution regulators meet system needs.

There's plenty of reason for praise like this. Allis-Chalmers voltage regulators are designed for fast, convenient servicing. A-C engineers understand the need for continuous operation and provide for it in their regulator's design.

Allis-Chalmers field service helps you get the most profit from your regulator operation. Field stocks of needed parts are available for fastest possible delivery. Factory service includes help in getting parts to you fast, plus engineering assistance whenever and wherever you need it.

Find out for yourself. Ask about Allis-Chalmers regulator service. Call the A-C office nearest you or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-4841

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Fischer Black, Publisher and Editor
Jesse Mock.....Asst to the Editor

Daniel T Braymer.....Managing Editor
Leonard M Olmsted.....Associate Editor
Kenneth K Kost.....Associate Editor
Herbert R Frankel.....Associate Editor
Rue M Shoop.....Associate Editor
George Swift.....Associate Editor
Edward Allen.....Midwestern Editor
H S Knowlton.....New England Editor
John J Kearney....Middle Eastern Editor
Francis Kovalcik.....Western Editor
Allen Long.....Northeastern Editor
David Rea.....Southeastern Editor
E Bryson Sessions.....Commercial Editor
Arthur J Stegeman.....Assistant Editor
James G Plunkett.....Assistant Editor
Denise Hennessy.....Editorial Assistant
Theodore W Fuller.....Editorial Assistant
Ary Mossiman.....Mgr, Market Research
Frank C Stockman.....Art Director
H T Howland, Jr.....Production Editor
G B Bryant, Jr..Mgr, Washington Bureau
V C Richter....Washington Correspondent
Dexter M Keezer.....Dir, Economics Dept
E Benoit-Smullyan.....Economist
A E Knowlton.....Consulting Editor

Domestic News Service: Atlanta, Chicago, Cleveland, Detroit, Houston, San Francisco.

World News Bureau: John Wilhelm, Editor; Bombay, Bonn, London, Mexico City, Paris, Rio de Janeiro, Tokyo.

Warren W Shew.....Sales Manager

District Managers: N V Palmer and E S Chapin, New York; E S Chapin, Boston; F P Coyle, Philadelphia; M S Kearney, Cleveland; M I O'Connell, Detroit; W H Meneilley and J T Schaefer, Chicago; J T Schaefer, St Louis; C W Dysinger, Los Angeles; R C Alcorn and T H Carmody, San Francisco; William Lanier, Atlanta; Douglas Billian, Dallas.

Otto Drechsel.....Business Manager

ELECTRICAL WORLD

Published weekly by McGraw-Hill Publishing Co., Inc., Executive, Editorial and Advertising Offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Office, 99-129 North Broadway, Albany 1, N. Y.

Donald C. McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A. Gerardi, Executive Vice President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publications Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; J. E. Blackburn, Jr., Vice President and Circulation Director.

Subscriptions: Address correspondence to Electrical World—Subscription Service, 99-129 North Broadway, Albany 1, N. Y. or 330 W. 42nd St., New York 36, N. Y. Allow one month for change of address.

Subscriptions are solicited only from executive, supervisory, and engineering personnel in electric utilities, manufacturing companies, and related fields. Position and company connection must be indicated on subscription orders.

Single copies 35¢. For the United States and possessions and Canada, $6 a year, $9 for two years, $12 for three years. Other Western Hemisphere, and the Philippines, $15 for one year, $25 for two years, $30 for three years. All other countries, $25 for one year, $40 for two years, $50 for three years. Entered as second-class matter at the Post Office at Albany, N. Y. Printed in USA. Copyright 1956 by McGraw-Hill Publishing Company, Inc. Permission required to reproduce any of contents.

Electrical World

Published for 82 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Vol. 146, No. 2 **July 9, 1956**

ELECTRICAL WORLD'S INDUSTRY REPORT
EXTRA HIGH VOLTAGE—BEST TRANSMISSION INVESTMENT..... 81

MANAGEMENT
SHOULD HE BE AN ENGINEER?.....Edward Steeve and John Scott 74
Electrical Business Outlook... 19 Your Business 21
Statistics ..... 20 Public Relations 174
Finance and Regulation..... 178

SUBSTATIONS
REVAMP BREAKERS FOR HEAVIER DUTY.....R. O. Bonine 76

METERING
INDIVIDUAL METERING IS FAVORED..... 101

DISTRIBUTION
4.16 KV WITH UNIT SUBS SERVES PITTSBURGH SHOPPING CENTERS R. R. West 78
CAPACITOR INRUSH CURRENTS OBTAINED FASTER.....H. C. Stone 107

MEETINGS
INTERNATIONAL CONFERENCE ON LARGE ELECTRIC SYSTEMS (CIGRE) 72
PEA ELECTRICAL EQUIPMENT AND RELAY COMMITTEES..... 176

ENGINEERING REFERENCE SHEET 106

INDUSTRIAL APPLICATIONS 116

HEATING AND COOLING ELECTRICALLY 124

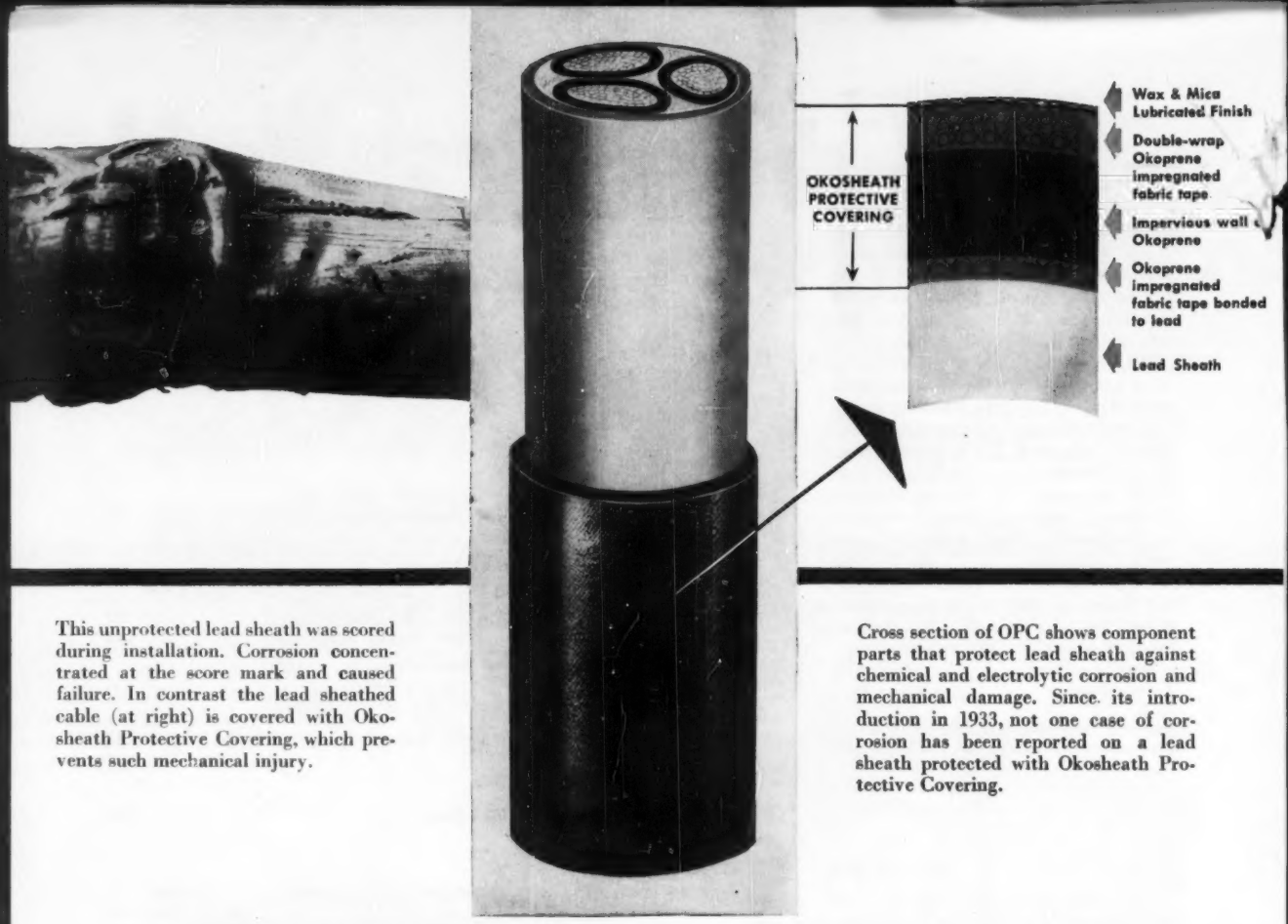
SALES AND SERVICE 126

INDUSTRY NEWS
Electrical Week ..... 66 News About People..... 162
Current Events ..68, 167, 168, 169 Sales Assignments 166
Manufacturing and Markets.. 156 Meetings Calendar 172

EQUIPMENT NEWS
New Equipment ..... 130 Catalogs and Bulletins..... 153
Technical Literature 155

EDITORIAL AND COMMENTARY
Technical Notes ..... 22 Washington Comment 22
Editorial 65

INDEX OF ADVERTISERS.....183



This unprotected lead sheath was scored during installation. Corrosion concentrated at the score mark and caused failure. In contrast the lead sheathed cable (at right) is covered with Okosheath Protective Covering, which prevents such mechanical injury.

Cross section of OPC shows component parts that protect lead sheath against chemical and electrolytic corrosion and mechanical damage. Since its introduction in 1933, not one case of corrosion has been reported on a lead sheath protected with Okosheath Protective Covering.

why Okosheath Protective Covering *eliminates lead sheath failure caused by scoring and corrosion*

Service records dating back to 1933 prove that Okosheath Protective Covering prolongs the life of paper-insulated lead sheathed cables for three main reasons.

1. Eliminates chemical corrosion—the substantial wall of Okoprene, free from fibrous materials that can wick-in moisture, is completely vulcanized and meets all the ASTM requirements for neoprene cable coverings. Okoprene provides excellent resistance to alkalies and acids in the soil. Firmly bonded by vulcanization to the sheath, it prevents any corrosive elements from contacting the lead and causing corrosion.

2. Stops electrolytic damage—the dense, homogeneous wall of Okoprene possesses stable electrical insulating properties which prevent electrolysis caused by stray currents. It is applied by Okonite's well-known strip-insulating process which assures a uniform wall thickness with no thin spots over the lead sheath.

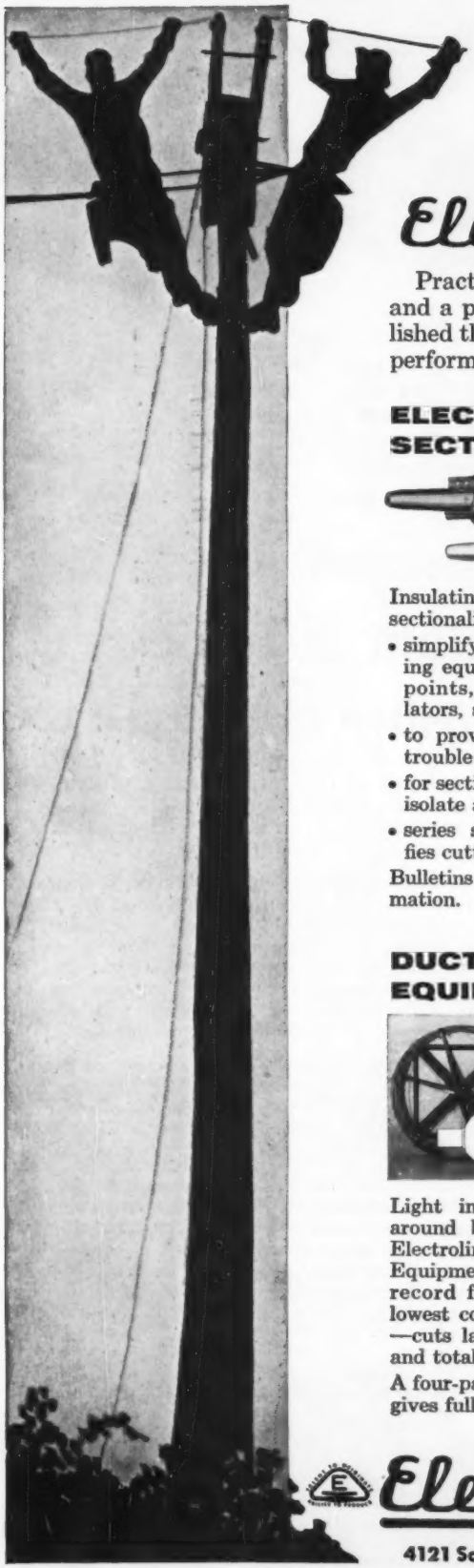
3. Prevents scoring of lead—because unprotected lead sheathed cable is vulnerable to scoring from abrasion during installation, its ability to resist internal pressure is greatly reduced. In tests, lead pipe sections having controlled score marks of 10% and 15% of their average thickness and subjected to internal pressure broke 17% and 31% sooner, respectively, than unscored pipes of identical thickness. The composite reinforced wall of Okosheath Protective Covering eliminates this possibility of mechanical damage to the lead sheath. In addition, pulling problems are reduced because the two outer layers of heavy fabric tape are slushed with a wax and mica finish.

For additional information on Okosheath Protective Covering write for Bulletin EW-1047.
Address: The Okonite Company, Passaic, N. J.

available with either copper or aluminum conductors

3912

OKONITE OKONITE SINCE 1878 ***insulated cables***

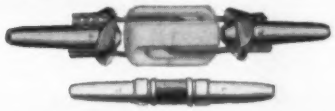


for the largest number of line applications, at the lowest possible cost . . .

Electroline Products

Practical experience designed these Electroline Products; and a practical habit of keeping close tab on costs has established them as first in the field—for top quality and economical performance.

ELECTROLINE SECTIONALIZERS

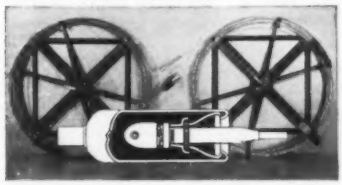


Insulating automatic line splice sectionalizers:

- simplify cutting-in of regulating equipment—disconnecting points, fuses, voltage regulators, series capacitors, etc.
- to provide points to test for trouble
- for sectionalizing networks—to isolate and test area in trouble
- series street lighting—simplifies cutting-in series lamps

Bulletins contain complete information.

DUCT-RODDING EQUIPMENT



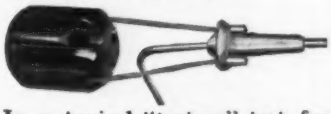
Light in weight, feeds easily around bends, easy to handle. Electroline Steel Duct-Rodding Equipment has an extraordinary record for high efficiency at lowest cost. A big money-saver—cuts labor cost, original cost and total investment.

A four-page illustrated brochure gives full information.

AUTOMATIC LINE SPLICES

It is well said of these simple, rugged units—"They go on in no time; they hang on for all time." Easy to install—and their mechanical strength exceeds the rated breaking strength of the conductors. Ideal for restoring service.

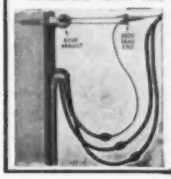
AUTOMATIC DEAD-ENDS



In a typical "torture" test for strength, gripping and vibration damping features, 100,125,000 recorded vibrations did not develop any sign of failure of conductor in these rugged dependable Dead-Ends. Engineers call it equivalent to 50 years of ordinary service.

Electroline Service-Drop Automatic Dead End. The "3800" Series for holding pre-assembled service cable using a bare neutral conductor as the messenger.

The method of gripping the bare neutral employed by this ELECTROLINE Anchorage eliminates the danger of short circuiting the phase wires so common with the use of concentric cable clamps.

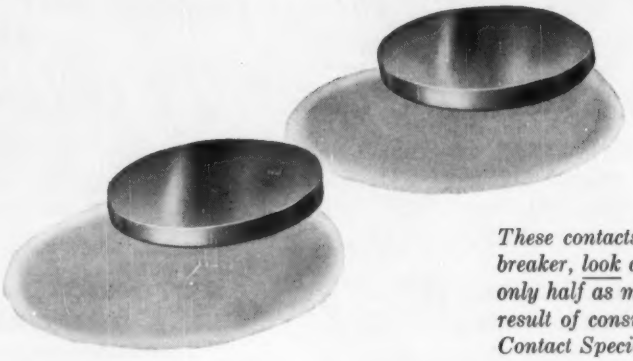


ELECTROLINE Service-Drop Anchor Bracket. The "4000" Series for securely supporting the cable at any angle.

Electroline Company

4121 So. LaSalle St., Chicago 9, Ill. *In Canada:* **POWERLITE DEVICES, LTD., TORONTO**

MALLORY



These contacts, for a utility circuit breaker, look alike . . . but one costs only half as much as the other, as a result of consultation with Mallory Contact Specialists.

How Mallory Contact Engineering Balances Performance and Price

Mallory Contact Engineering Offers Five Ways To Improve Economy

1. **The most effective contact material** from the extensive line developed by Mallory. More economical alloys often can satisfy *actual* service conditions.
2. **The most economical contact design . . .** for your purchasing, production and product needs.
3. **The most economical backing material** . . . from a group of Mallory alloys developed for this use.
4. **The most economical backing member design** . . . in relation to contact and product design requirements.
5. **The most economical method of assembly** of contact and backing member.

By coordinating *all* these important elements of contact design, Mallory can help you put into effect a long-range plan for cutting contact cost and assuring peak performance.

CONTACTS can be *too good* for their intended service. Detailed study of a contact application, by Mallory engineers, often uncovers ways to design more closely to actual requirements . . . at substantial savings to the customer.

The contact pictured above is a typical example. Intended for use in a circuit breaker for utility distribution lines, it originally was designed with contacts made of heavy-duty silver ELKONITE®. At first glance, this exceptionally long-wearing, high conductivity metal appeared ideal to meet the customer's original specifications. But further investigation by Mallory contact engineers revealed that while contacts had to operate with absolute dependability, they did not have to function *frequently*.

On the basis of the actual frequency of service expected, Mallory engineers recommended a change to a copper ELKONITE . . . an alloy made of lower priced materials, and more economical to produce. Overall savings to this customer amounted to a 50% cut in contact costs. Moreover, there is no sacrifice in performance for the specific application.

Chances are that consultation by Mallory on your own contact applications can prove the source of interesting savings for you. Mallory engineers are well qualified by years of experience to analyze your requirements, to recommend materials from the extensive line of Mallory alloys, and to assist in overall design of contacts and assemblies. For a discussion, write or call Mallory today.

Expect more . . . get more from

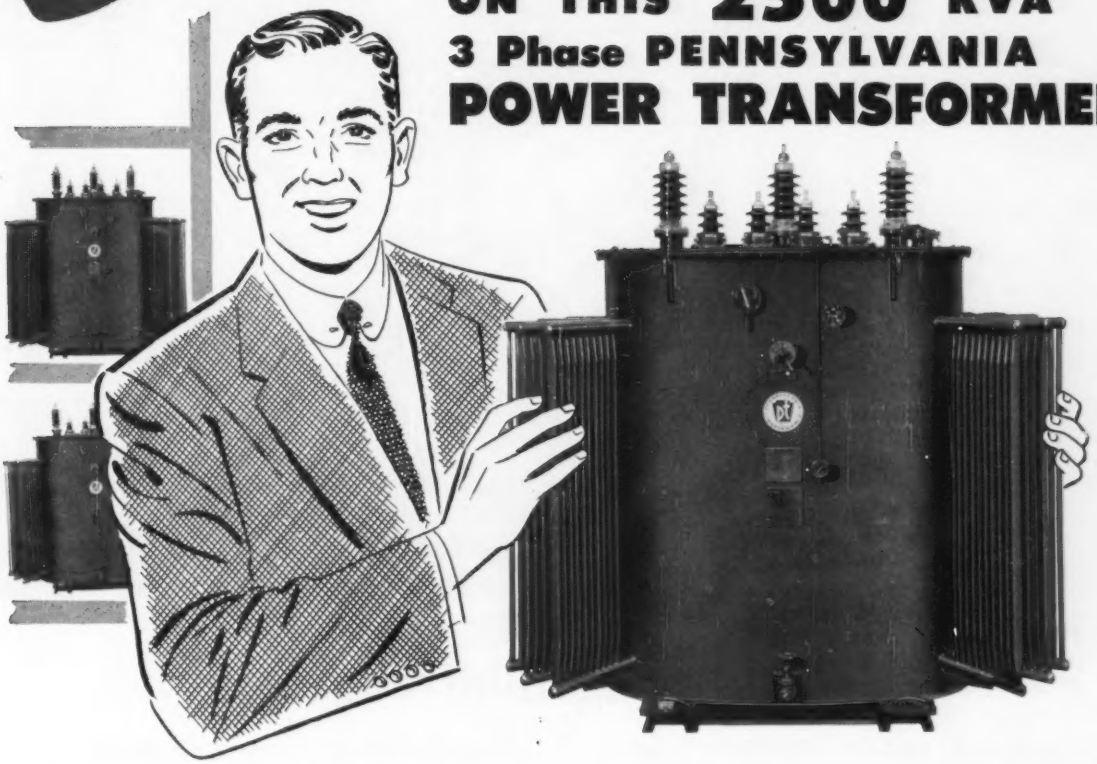
P. R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Serving Industry with These Products:

Electromechanical—Resistors • Switches • Tuning Devices • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals • Welding Materials

Save $943.00 AND MORE

ON THIS 2500 KVA 3 Phase PENNSYLVANIA POWER TRANSFORMER



Actually you can save as much as $1055* on 2500-kva, three-phase transformers like this one — by taking advantage of the cost reductions Pennsylvania is able to pass along to you when you specify *Standard Parts* power transformers. "Standard Parts" means that kva, voltages, and accessories are within the range of standardized units outlined in ASA Standards C57.12A.

Similar savings — *up to 8% of the basic cost of a transformer* — can be yours for any units 833 kva through 5000 kva single phase, and 750 kva through 10,000 kva three phase, in voltages up to 69 kv.

And . . . your initial dollar savings are just part of the story. You also . . .

Get quicker deliveries, because designs are already made up and many standard parts are already in stock.

Save on installation, because most *Standard Parts* power transformers are shipped completely assembled and ready to connect to your lines.

Save on maintenance, because Pennsylvania *Standard Parts* power transformers feature all-sealed construction, which means there are no external auxiliary tanks and fittings to maintain.

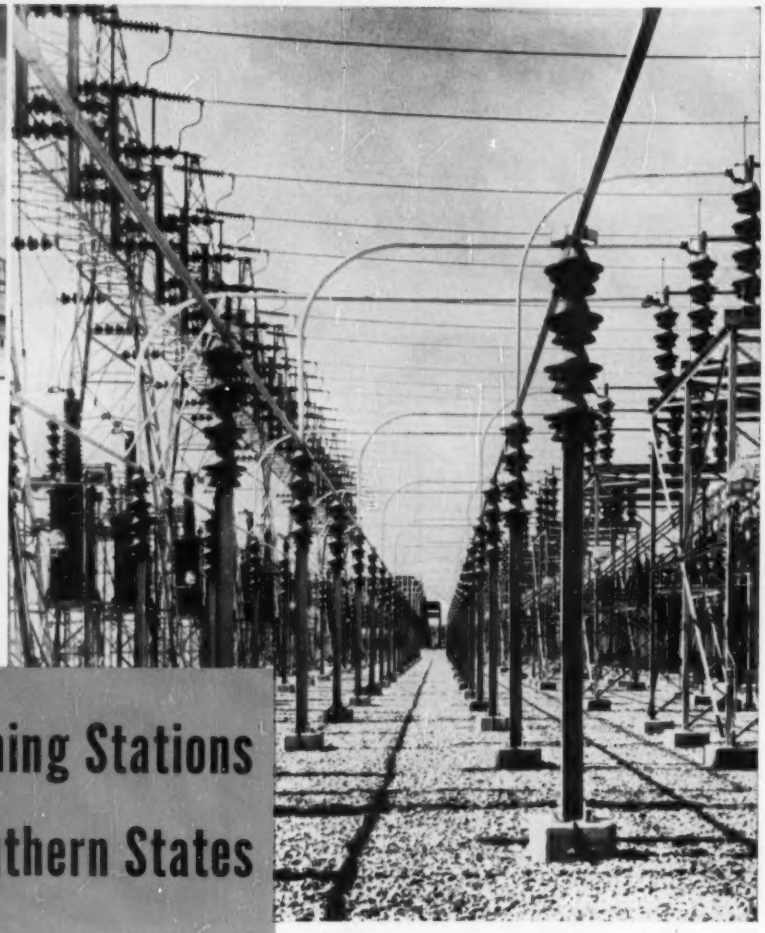
If your transformer requirements fall within the sizes listed above, make it a point to find out about Pennsylvania *standard parts* power transformers. You may save as much as 8%!

* 34,400 volts is a standard high voltage rating. The 31,350△ rating of this transformer is within the optional high voltage range, adding 1% to the net cost of the *Standard Parts* transformer.

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division **CANONSBURG, PA.** *Greater Pittsburgh District*

PADUCAH, KY.—AEC plant's 25-acre switchyard where two stations supplied by Southern States use a total of 128 Type WAG Air Break Switches.



Paducah Switching Stations Supplied by Southern States

THE ATOMIC ENERGY COMMISSION'S plant at Paducah, Kentucky, has about 25 acres of electrical switchyards. Power fed through the yards is about 17 billion kwh annually. The structures and much equipment for two switchyards in this AEC development were supplied by Southern States—C-31 with 500,000 kva capacity, and C-33 with 1,000,000 kva capacity. Nearly a million pounds of steel were required for the two structures which occupy over one-quarter of a million square feet.

Among the Southern States equipment supplied with the structures were 128 Type WAG Air Break Switches. Of them, 121 were rated 161 kv-1200 amperes; four were rated 161 kv-600 amperes; and three 15 kv-2000 amperes.

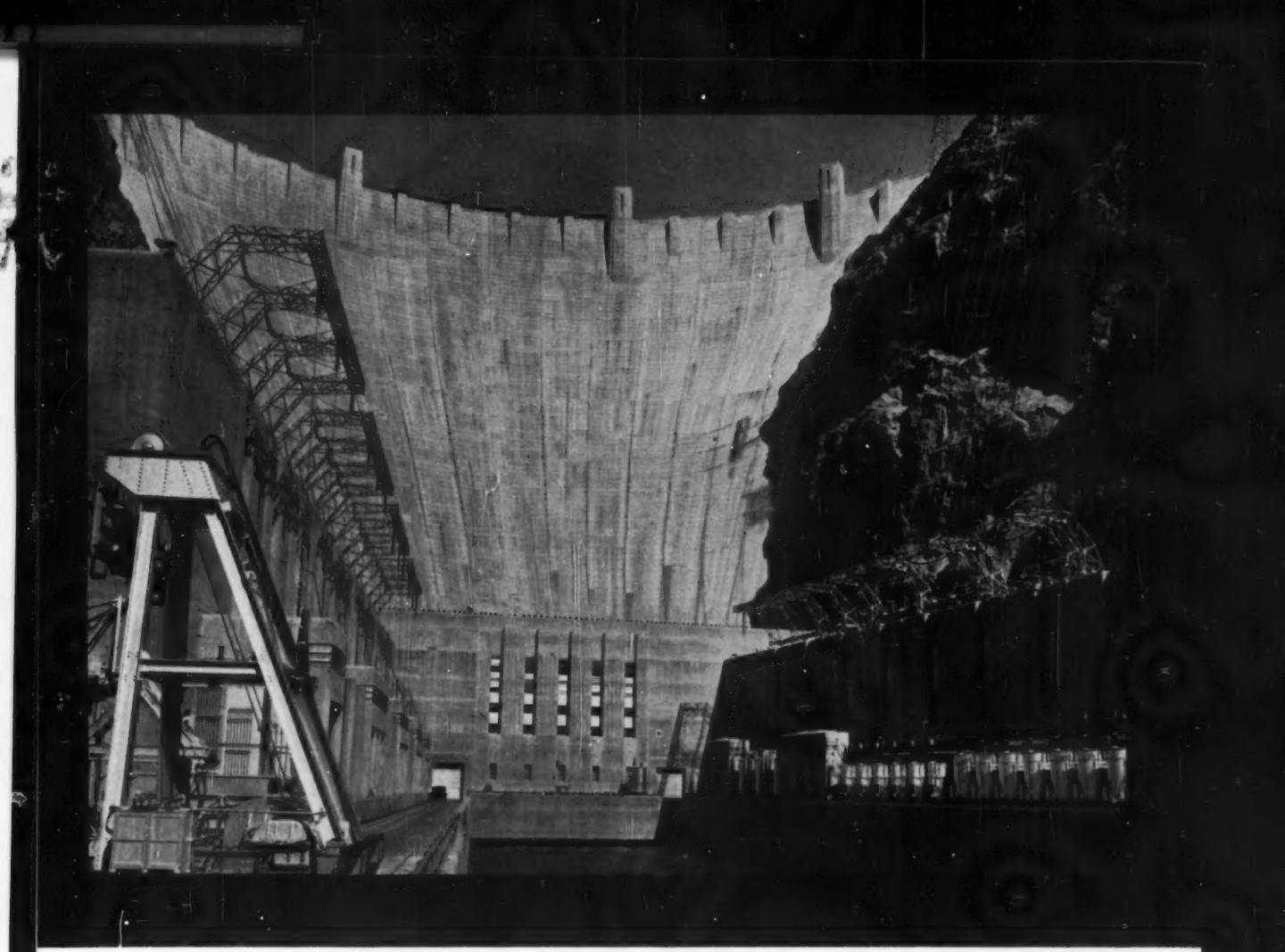
This is another example where Southern States equipment was used for one of the nation's largest installations—a fact worth remembering when ordering or specifying equipment that demands dependability and performance.

SS®

SOUTHERN STATES EQUIPMENT CORP.

HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto



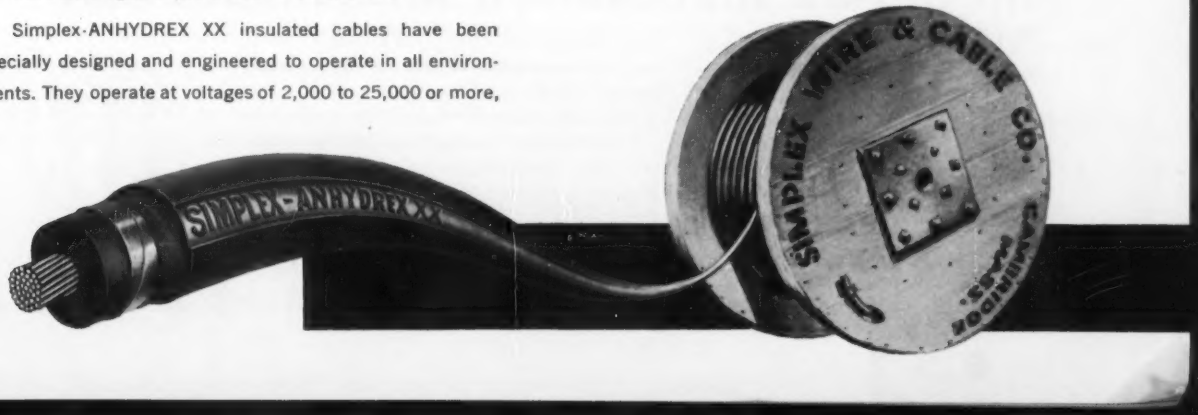
The responsibilities of being BIG

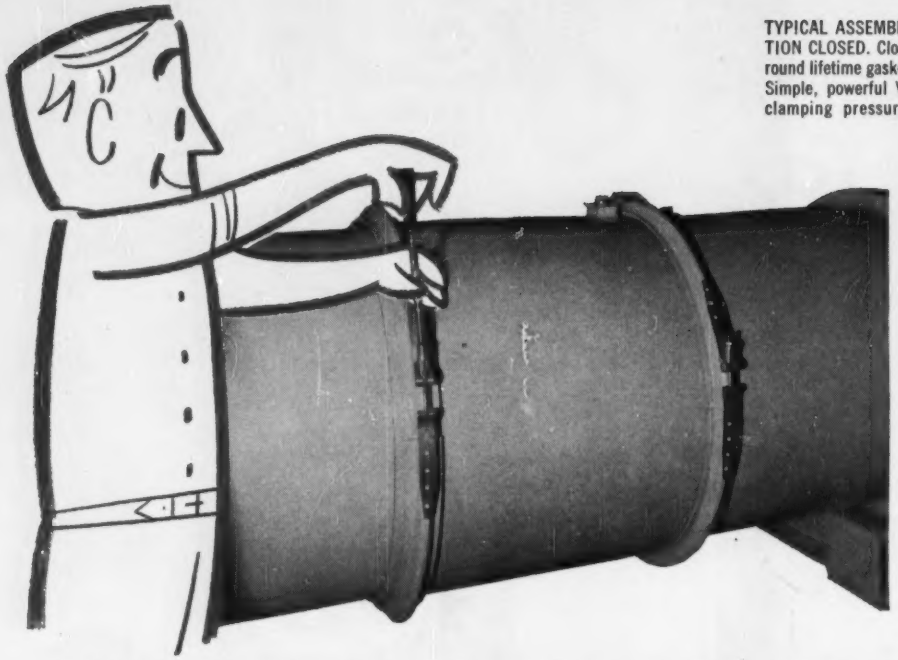
Management of huge power installations like this imposes a heavy load of responsibilities, indeed. Chief among them is the imperative necessity of maintaining power transmission at a steady, constant level.

Throughout the world, Simplex-ANHYDREX XX insulated cables are used extensively in power and communication transmission. Their proved performance and dependability are assurance against power loss or breakdown.

Simplex-ANHYDREX XX insulated cables have been specially designed and engineered to operate in all environments. They operate at voltages of 2,000 to 25,000 or more, at a conductor temperature as high as 85°C, for cables up to 17 KV. The ANHYDREX XX insulation is impervious to the action of ozone or other oxidizing agents.

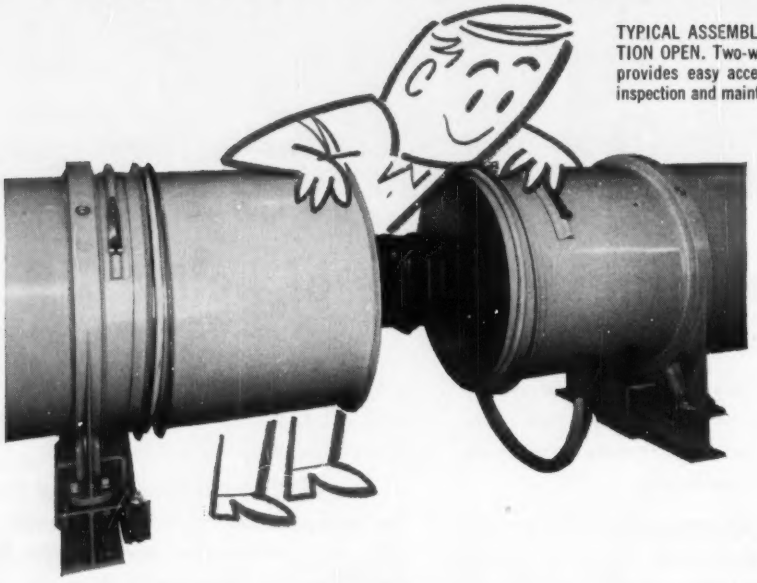
Simplex-ANHYDREX XX is the logical choice for your high voltage applications. Write for our booklet 1009, which gives complete information. **SIMPLEX WIRE & CABLE CO.,** 79 Sidney Street, Cambridge 39, Mass.





TYPICAL ASSEMBLY WITH TELESCOPING SECTION CLOSED. Closure requires only two 1-piece round lifetime gaskets—easy to place and remove. Simple, powerful V-clamp couplings distribute clamping pressure uniformly around the ring.

New design of I-T-E Isolated Phase Bus



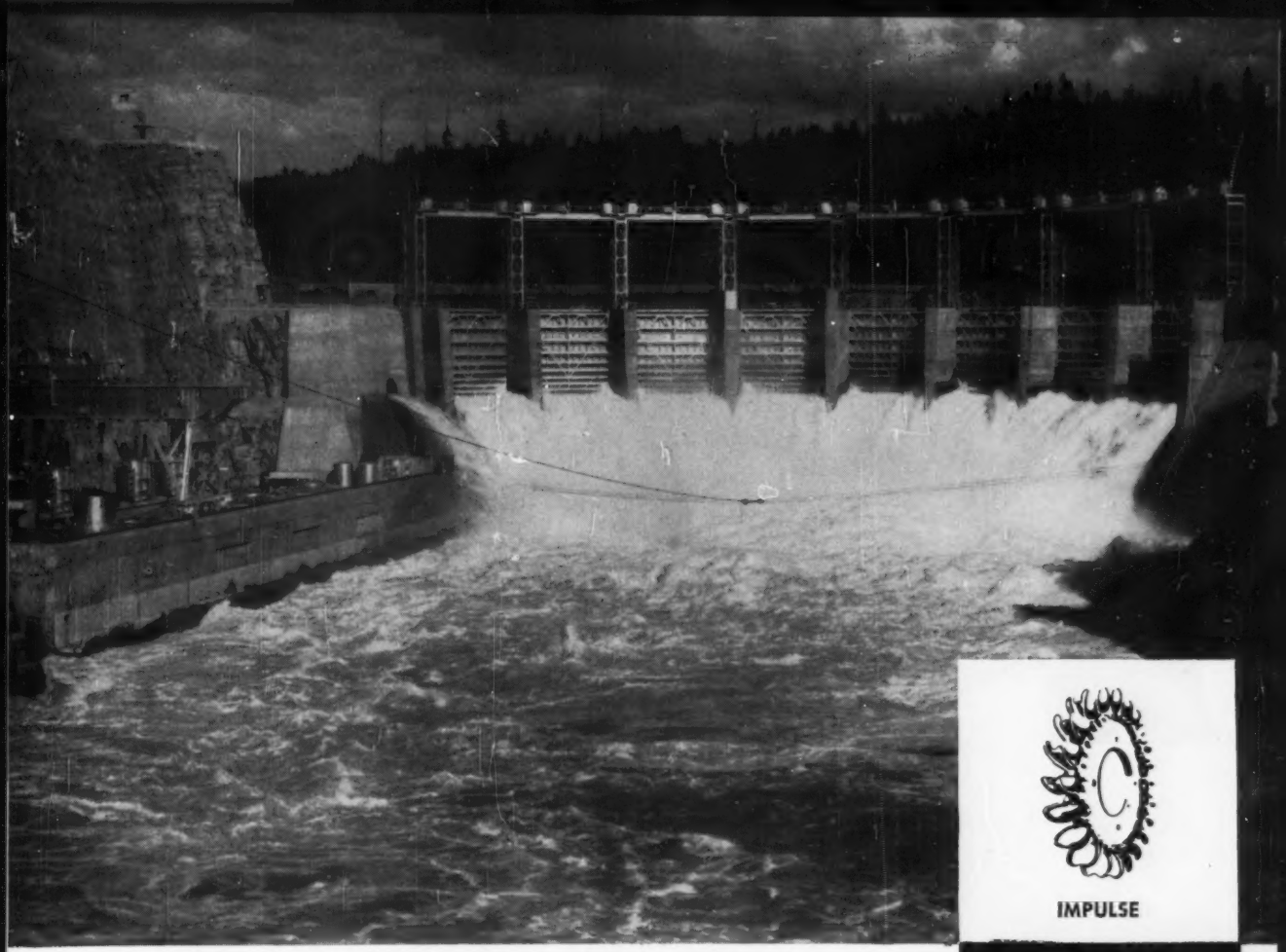
TYPICAL ASSEMBLY WITH TELESCOPING SECTION OPEN. Two-way sliding telescoping section provides easy access to connectors—simplifies inspection and maintenance.

simplifies installation and inspection

All-welded aluminum basic assemblies—joined together with 2-way sliding telescoping sections—cut installation and inspection time. A V-clamp closure and a 1-piece round gasket in each telescoping section joint assure a permanently tight seal. This new design reduces gasketing 75%. In addition, it combines great strength and light weight with structural simplicity. And smooth inside surfaces prevent the accumulation of moisture.

Bulletins 10004-A and 10004-B describe I-T-E Isolated Phase Bus designs. For copies of these bulletins, write I-T-E Circuit Breaker Company, 19th and Hamilton Sts., Phila. 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division



Hydroelectric plant of The Washington Water Power Company at Cabinet Gorge. Three BLH fixed blade propeller turbines and one BLH Kaplan turbine produce 282,000 hp here.

how BLH can help solve your turbine problems

Here are four ways we can help you:

- We have excellent hydraulic laboratories for testing scale models under simulated operating conditions. Laboratory tests assure proper design of turbines to meet your specific conditions.
- Eddystone and Pelton Divisions of BLH Corporation have been designing and building turbines since 1841. There's no substitute for experience, and our experience is all yours to command.
- We build all four basic turbines—Impulse, Kaplan, Francis and Propeller type. You can be sure that our recommendations are objective.
- We manufacture surge suppressors, valves, pumps, governors and other accessory equipment. You place all responsibility in one source of supply.

Would you like a copy of our 22-page catalog illustrating and describing our hydraulic power equipment and typical installations? Write to BLH Corporation, Philadelphia 42, Pennsylvania, or Dept. 5007, Pelton Division (BLH), 2929 Nineteenth Street, San Francisco 10, California.

EDDYSTONE DIVISION
BALDWIN-LIMA-HAMILTON

DIVISIONS: Austin-Western • Eddystone • Hamilton • Electronics & Instrumentation • Lima • Madsen • Loewy-Hydropress • Pelton • Standard Steel Works

IMPULSE

KAPLAN

FRANCIS

PROPELLER

How does it compare with

WHAT IS AAAC? —

AAAC is a high-strength, high-electrical conductivity heat-treatable aluminum-magnesium-silicon alloy developed by Kaiser Aluminum. Through the combination of proper heat treatment and cold reduction, wire is produced having exceptional mechanical strength yet with electrical conductivity only moderately reduced from that of pure E.C. aluminum.

HOW DOES AAAC COMPARE IN EFFICIENCY?

$$\frac{\text{Tensile Strength} \times \text{Conductivity}}{\text{Specific Gravity}}$$

The above formula may be looked upon as a rough criterion for conductor metal efficiency in high tensioned overhead line construction. Using this efficiency criterion, AAAC is:

1. almost 50% more efficient than hard-drawn copper
2. almost twice as efficient as E.C. aluminum
3. about 25% more efficient than ACSR.

DOES AAAC HAVE INSTALLATION ADVANTAGES?

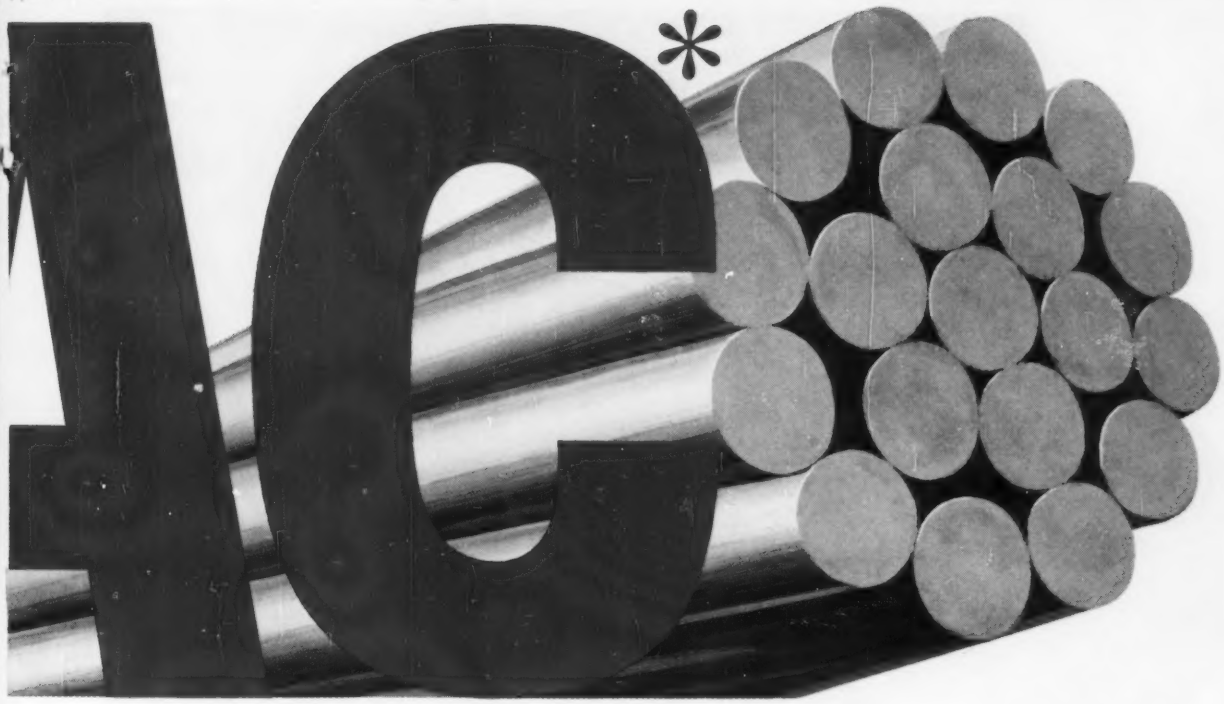
AAAC is as simple to splice and dead-end as all-aluminum or copper cables. For splicing, *only a single compression sleeve is required.* This eliminates the separate steel sleeve, and the cutting back of strands necessary when splicing ACSR. Automatic or preformed splices can develop the full strength of the conductor without special preparation. For dead-ending, suitable bolted-type clamps can develop the full conductor strength. All this means that in many cases fittings will be less costly than those for ACSR, installation time will be less, and rapid emergency repairs may be made more quickly even when the line must remain energized during repair. Armor rods satisfactorily used on ACSR can also be used on AAAC. Repair sleeves, armor rods, clips, Corona balls and dampers are interchangeable because of equivalent sizes.

WHAT ABOUT SIZES?

AAAC is designed in sizes to be approximately equivalent to ACSR conductors (in outside diameter, d-c resistance and breaking strength).

	SIZE	DIAM. (IN.)	STRENGTH (LBS.)	R-DC @ 20°C OHMS/1000 FT.	WEIGHT LBS/1000 FT.
ACSR	6–6/1	0.198	1170	0.6580	36.1
AAAC	6–7	0.197	1068	0.6580	28.2
ACSR	2–6/1	0.316	2790	0.2602	91.3
AAAC	2–7	0.314	2700	0.2602	71.4
ACSR	1/0–6/1	0.398	4280	0.1635	145.2
AAAC	1/0–7	0.395	4290	0.1635	112.4
ACSR	4/0–6/1	0.563	8420	0.0816	291.1
AAAC	4/0–7	0.565	8430	0.0816	232.1

* *The initials AAAC are not a trade-mark of Kaiser Aluminum, but are regarded as a grade designation for All Aluminum Alloy Conductor (developed by Kaiser Aluminum). The initials are intended to be used freely throughout the industry in designating such products, as is the case with grade designation ACSR, Aluminum Conductor, Steel Reinforced. While testing continues AAAC will be available in limited quantities through Kaiser Aluminum sales offices and distributors; redraw rod will later be available to other fabricators of electrical conductor.*



other forms of conductor?

WHAT IS THE CORROSION RESISTANCE OF AAAC?

AAAC is mono-metallic and the alloy has great inherent corrosion resistance. Galvanic corrosion, that may sometimes occur between the steel core wires and adjacent aluminum strands in an ACSR conductor in severe environments, cannot take place with AAAC.

WHAT ABOUT THE OPERATING COSTS OF AAAC?

For the same current carried AAAC will operate cooler than ACSR with a cost-saving and lower watt loss per foot of conductor. Inductive reactance of AAAC at one foot spacings is approximately 10% lower than the equivalent ACSR and, for a given length, will have less voltage drop.

HOW DURABLE IS AAAC?

AAAC has about twice the Brinell hardness of hard-drawn E.C. aluminum. It will, therefore, not abrade so readily as all-aluminum or ACSR conductors during installation nor will it wear to the same extent in ties, dead-ends and clamps.

HOW DOES AAAC COMPARE IN TENSILE STRENGTH?

Since AAAC has the same metal area as ACSR and has the same composite strength, the conductor strength will be the same as its ACSR equivalent. This value is shown in the table where the size comparison is made.

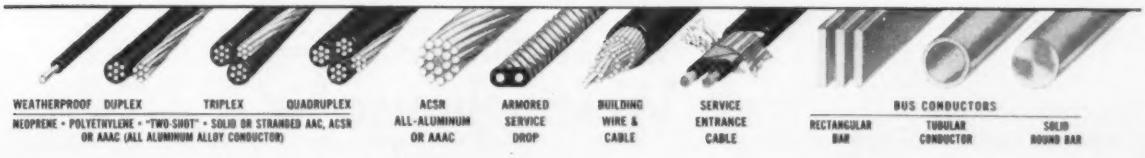
For more detailed information about this important new Kaiser Aluminum development, see any Kaiser Aluminum sales office or one of our many distributors.

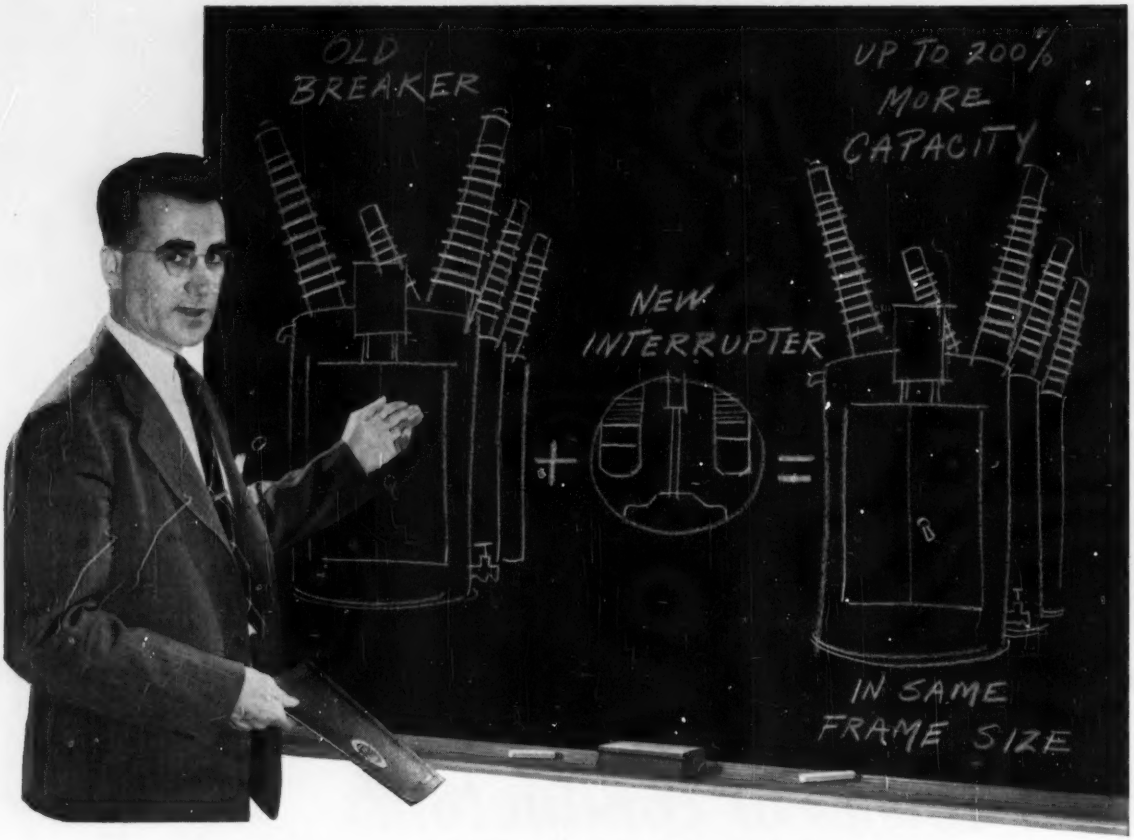
Kaiser Aluminum & Chemical Sales, Inc., *Executive Office*, Kaiser Bldg., Oakland 12, California; *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois.

Kaiser Aluminum

Aluminum is the answer to Adequate Wiring

See "THE KAISER ALUMINUM HOUR" Alternate Tuesdays, NBC Network. Consult your local TV listing.





J. W. Stirling, Power Circuit Breaker Sales Mgr., advises . . .

Meet load growth, lick costs with unique breaker Modernization Plan

The shortest distance between old breakers and new breakers is the Westinghouse Modernization Plan. The plan is simple and costs approximately one-third the price of completely new equipment, installed.

This is how it works. You tell us the style and rating of your present breakers. We will provide you with a new interrupter and contact assembly for the Westinghouse O, G, GO or GM frame-mounted or floor-mounted breakers. Install the interrupters yourself; neither tanks nor foundations need be disturbed. The result? Rejuvenated breakers . . . additional capacity of anywhere from 50% to 200%, and added breaker life of up to 15 years.

Interrupters furnished are, of course, the exclusive Westinghouse magnetic De-ion® or multi-flow De-ion grid types which offer you standards of performance your present equipment can no longer provide.

Have your Westinghouse sales engineer give you final details of this quick and inexpensive breaker Modernization Plan, or write to Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. J-60882

YOU CAN BE SURE...IF IT'S
Westinghouse

We say this without reservation—will back it up with proof:

New Balanced Mobil D.T.E. Oils Can Improve Your Production And Reduce Manufacturing Costs

For years Mobil D.T.E. oils have set the standard of quality for all hydraulic and circulating oils. Recently they were dramatically improved—so much so that their margin of superiority is now greatly increased.

New Mobil D.T.E. oils are *balanced* to meet the widest range of operating conditions. They will give years of trouble-free service—even in continuous high temperature circulating systems. They will keep your machines free from deposits over the complete range of service. They will give you the highest degree of protection against wear... rust... corrosion. In fact, tests show *most machines will become obsolete before these oils need changing* when operating at normal temperatures.

Let us show you concrete *proof* that new balanced Mobil D.T.E. oils can improve production and cut manufacturing costs. Ask your Mobil representative for the "balanced" story.

SOCONY MOBIL

FIRST STEP IN CUTTING COSTS

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

HERE'S ANOTHER WAY...

Preformed Guy-Grips CUT GUYING COSTS!

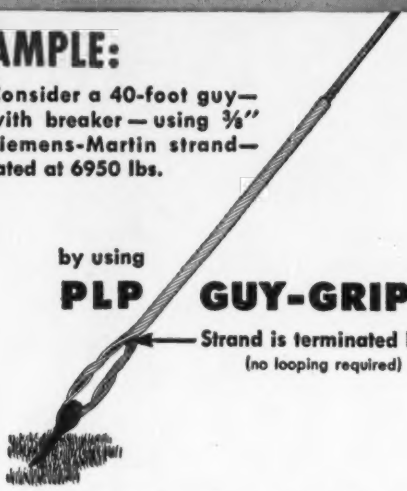
EXAMPLE:

Consider a 40-foot guy—with breaker—using ⅜" Siemens-Martin strand—rated at 6950 lbs.

by using

PLP GUY-GRIPS

Strand is terminated here
(no looping required)



1 Since PLP Guy-Grips eliminate looping, strand saving of 12 feet or more per guy results. **SAVING: $.67 per guy**

2 Substitute ¼" Extra High Strength Strand—rated 6650 lbs. PLP Guy-Grips make this possible since they hold the full rated strength of E.H.S. Strand. The following strand savings result (current cost of ⅛" galvanized strand is $2.24 per guy while ¼" E.H.S. costs $1.36 per guy)*: **SAVING: $.88 per guy**

TOTAL STRAND SAVING ALONE: $1.55 per guy

3 Preformed Guy-Grips cost only $.55 each for ¼" E.H.S. Strand size. (PLP Cat. No. 25 GDE-¼")

Compare this cost with your current fitting.

PLUS LABOR SAVINGS

In every Preformed Guy-Grip installation, you hold the full strength of the strand.

☑ CHECK THESE ADDITIONAL SAVINGS:

- ✓ With PLP Guy-Grips, leading utilities estimate installation savings upward of 50%.
- ✓ Save an additional 10% by using 3-wire strand instead of 7-wire. PLP Guy-Grips will hold 3-wire strand equally well.
- ✓ Save space and inventory costs by standardizing on PLP Guy-Grips and lighter E.H.S. Strands. One size strand can be substituted for several sizes and grades previously used.

PLP GUY-GRIPS ARE ALSO AVAILABLE IN COPPER-WELD, BRONZE, AND STAINLESS STEEL.

**Based on current strand prices—75,000 feet to carload lots.*

PLP GUY-GRIPS DON'T SLIP . . . even under impact!

Made in accordance with or for use under one or more of the following U.S. Patents: 2,373,319; 2,397,321; 2,508,033; 2,691,863; other patents pending.

PREFORMED LINE PRODUCTS COMPANY

8349 ST. CLAIR AVENUE • CLEVELAND 3, OHIO

Keystone Aluminum Conductor System Installed at Penna. R.R. Shops

ASSURE 7 WAY SAVING IN WEIGHT...POWER...LABOR

THIS IS AN immense project—the new car repair shop of the Pennsylvania Railroad. The shop is 2760 ft. long; 15 overhead cranes are required with capacities up to 25 tons. To furnish electrical connections for the cranes two 3-rail Keystone Aluminum Conductor Systems, each running the full length of the shop, were specified and installed.

Keystone was judged best qualified to meet the rigid conditions required of this installation. It was selected because it would . . .

SAVE TRANSFORMERS—Three installations needed with steel conductors are eliminated with Keystone Aluminum Conductor System.

SAVE FEEDER RUNS—With this non-magnetic system, all but the center tap is eliminated.

SAVE BOOSTER CABLES—System capacity permits satisfactory operation ¼-mile from feeder without boosters.

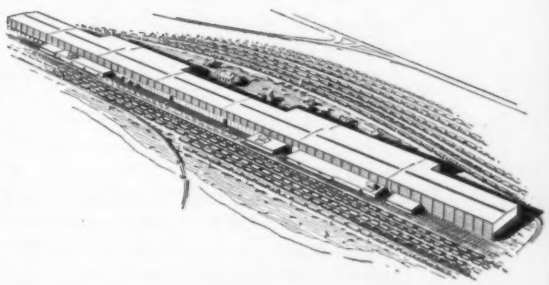
SAVE CAPACITY—Compact design permits close conductor spacings, minimizing impedence drop, reducing conductor size.

SAVE ENGINEERING COSTS—Integrated package design, factory assistance reduce time and effort.

SAVE INSTALLATION COSTS—Lightweight components, factory prefabrication, foolproof design cut erection time and cost.

SAVE OPERATING COSTS—Adequate voltage supply assures maximum crane operating speeds, reduces motor overloads. Protected contact surfaces eliminates shutdowns on exposed systems.

Keystone Aluminum Systems are now operating countrywide on AC and DC runways from 50 to 2760 ft. long, and on ore bridges and unloaders. Standard components range from 500 to 1000, 2000, 3000 and 6000 amp. capacity. Write today for case histories—*"Solving Conductor Problems."*



NEW SAMUEL REA SHOP at Hollidaysburg, Pa. where 50 steel hopper and gondola cars will be rebuilt each day. Large photo above shows 5 of the 15 overhead cranes, 2760-ft. runway; insert shows close-up of Keystone three-rail collector assembly. The Harry F. Ortlip Company of Philadelphia, specialists in railroad engineering and one of the largest electrical construction firms in the East, made the installation for Pennsylvania Railroad.

ELECTRIC SERVICE MANUFACTURING CO., PHILADELPHIA 32, PA.

KEYSTONE

NOW

S&C positrol fuse links

provide complete protection for pole-top capacitor banks

S&C Positrol Fuse Links will give you adequate, economical protection of pole-mounted capacitor banks—even considering the more difficult fusing requirements of ungrounded wye-connected banks.

Available in a complete series of ratings, Positrol Fuse Links have a margin of safety to withstand overload conditions and short duration transient currents considerably above ratings. Unnecessary outages are eliminated, but fuse action is rapid and dependable in the event of a faulted capacitor.

And, since these fuse links employ the S&C magnesium borate "Arctrol" sleeve, interruption of low-current faults is faster, more effective, and less violent.

Information Bulletin 500 explains in detail "The Fusing of Pole-Mounted Capacitors." It provides application tables to facilitate the selection of the correct fuse links for every capacitor fusing problem. It should be added to the technical library of every distribution engineer.

Specialists in High-Voltage Circuit Interruption since 1910

Write for new Bulletin 500 which gives valuable information on capacitor bank fusing.

S&C ELECTRIC COMPANY

4421 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U. S. A.

In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario

POWER FUSES • DISTRIBUTION CUTOUTS AND FUSE LINKS • LOAD INTERRUPTERS • METALCLAD SWITCHGEAR

ELECTRICAL BUSINESS OUTLOOK

Electrical World
JULY 9, 1956

The new $33 billion Federal Highway Program spells out both good and bad news for the nation's electric utilities.

Higher taxes on new trucks and gasoline alone will hit utilities for an extra $1.8 million dollars a year beginning July 1 (over $1.5 million of this will be in the form of increased gasoline taxes). And that's a rock bottom estimate based on the number of trucks and the gallons of gasoline utilities will buy in 1956. You can expect this figure to keep climbing each year as vehicle fleets and mileage increase. To figure your tax bill add 1¢ to the cost of every gallon of gas you buy, increase the manufacturer's sales tax on trucks from 8% to 10% and then add 3¢ a lb to each new tire you buy—that's the bad news.

• • •

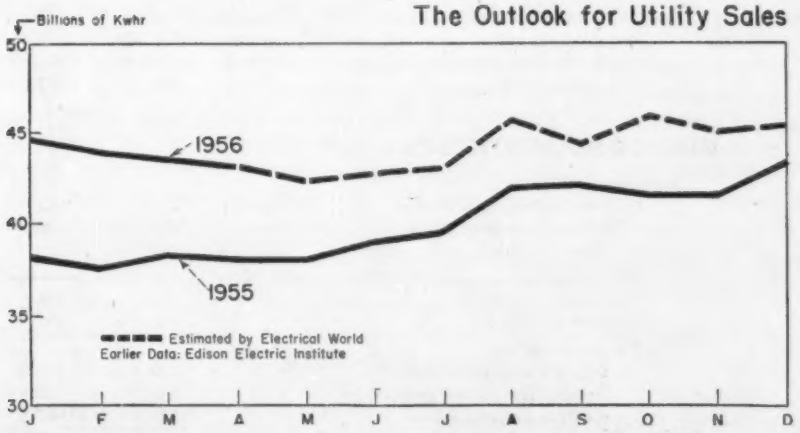
The encouraging part of the highway program is the large potential market it offers utilities for the sale of fly ash. Bituminous Coal Research Inc, a coal industry association, reports successful application of fly ash in both asphalt and concrete roads. Using BCR estimates, about 2,500 tons of fly ash could be used in each mile of 4-lane asphalt highway. This adds up to a potential market of over 102 million tons of fly ash for 41,000 miles of new roads in the next 13 years—more than 17 times the tonnage of fly ash produced by all utilities in 1953.

Financially, this would mean an extra $103 million that could be deducted from the cost of coal in the next 13 years if fly ash is used in only 50% of the new highways (based on a market value of a $1 a ton and the saving of a $1 a ton on the present average cost of disposal). To the Federal government it would mean a potential saving of about $10,000 per mile of 4-lane highway. This would cut the cost of the entire program by about $½ billion—or 1½%.

• • •

Structural steel is expected to be in short supply at least until 1958—and even then you can expect lead time to be considerably longer than the 12 to 20 months reported here in June. Booming commercial construction had already created a shortage—even before the steel mills shut down. Now a stepped-up road building program promises to make an already bad situation even worse. The thing to keep in mind is that the highway program won't get into high gear until 1958—then it will really develop an appetite for structural steel.

The Outlook for Utility Sales



STATISTICS

Capital Expenditures Will Set a New Record in The Third Quarter

Total Business Expenditures for New Plant and Equipment†
Billions of dollars — seasonally adjusted at annual rates

	1955				1956		
	Jan-Mar	Apr-June	July-Sept	Oct-Dec	Jan-Mar	Apr-June*	July-Sept*
Manufacturing	10.17	10.84	11.97	12.48	13.45	15.15	16.07
Durable	4.78	5.06	5.77	6.00	6.57	7.90	8.55
Nondurable	5.39	5.78	6.20	6.48	6.88	7.25	7.52
Mining	.80	.94	.99	1.08	1.13	1.14	1.28
Railroad	.74	.80	.96	1.17	1.25	1.28	1.46
Transportation (other than rail)	1.46	1.62	1.60	1.70	1.65	1.68	1.89
Public utilities	4.01	4.09	4.43	4.48	4.56	4.95	5.28
Commercial and other**	8.46	8.90	9.70	10.54	10.78	10.57	10.76
Total	25.64	27.19	29.65	31.45	32.82	34.77	36.74

† excludes agricultural outlays and spending charged to current account
* estimates based on anticipated expenditures reported by business in late April and May
** includes trade, service, finance, communication and construction

Power Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity	April	116.78	116.56	105.30	10.9
Peak—Class I Systems (million kw)	April	91.4	92.3	82.4	10.9
Estimated Dec. '56 Peak (million kw)	April	105.88	105.68	103.39	2.4
Production—billion kwhr	April	47.49	50.34	42.03	13.0
Hydro		11.55	11.78	10.46	10.4
Fuel		35.94	38.56	31.57	13.8
Sales—billion kwhr	April	44.51	45.36	39.53	12.6
Residential		11.82	12.42	10.60	11.4
Commercial		6.70	6.84	6.15	8.9
Industrial		23.53	23.69	20.42	15.2
Other		2.46	2.40	2.36	4.2
Fuel Consumption	April				
Coal—million tons		11.95	13.39	10.12	18.1
Oil—million barrels		5.76	6.22	5.68	1.4
Gas—billion cu. ft		89.72	85.17	92.82	−3.3
Net Income Class A & B Co's—$ million	April	115.46	117.46	104.90	10.1
Residential Customers—millions	12 mos.	44.67	44.60	43.42	2.9
Revenue per kwhr	ended	2.63¢	2.63¢	2.68¢	−1.9
Avg kwhr per customer	Mar. 31	2,819	2,799	2,607	8.1
Avg annual bill		$74.12	$73.67	$69.87	6.1

Business Statistics . . .

Indexes: 1947–49 = 100					
FRB Industrial Production	April	143	143	138	3.6
ENR Construction Cost	June	145.2	144.4	137.5	5.6
BLS Cost-of-living	April	114.9	114.7	114.2	0.6
NEMA Sales	April				
Insulation materials		163	168	160	1.9
Electric appliances		111	120	102	8.8
Wholesale prices	April				
Motors and generators		130.4	126.9	120.5	8.2
Transformers and regulators		135.3	133.1	127.3	6.3
Switchgear and fuses		149.0	147.8	135.5	10.0
GNP—annual rate—$ billion	1st Qtr.	398.5	397.3	375.3	6.2

Your Business

All set for your vacation? If not, don't fret. An unplanned one can sometimes be much more fun than one you've prepared for all winter. A change of pace is the best relaxation. If you've been in the hometown most of the year, a trip may be your answer. If you've been on the run a lot, your best vacation spot may be right in your own backyard. Or if your wife is all set for a trip, see if you can't compromise—half on the road, half at home.

Skimping on vacation expenses doesn't need to take all the fun out of your two weeks off. State and national parks offer many vacation facilities and food at moderate cost. If you're willing to wait until after Labor Day, you may still be able to get a cabin or rooms at one of the parks. A letter to National Park Service, Interior Department, Washington 25, D. C., or the agency administering state parks at your state capitol will get you the information you need. If you have camping equipment, you should be able to find tent space in a number of state and national parks during the summer. If you are willing to take your vacation off the beaten path, you'll probably find food and lodging much more reasonable.

"Hey Joe—wanna see the palest cable installer you ever saw?"

Watch the vacation hazards. Overexertion, especially if you're accustomed to a sedentary life, can do real damage. Too much sun can cause sun burn or sun stroke. Surf bathing, if you're not accustomed to it, better be tackled cautiously. Swim on patrolled beaches whenever possible. Watch the offsets, which some people mistakenly call undertow. They can be tricky and dangerous.

Your Health—Ileitis: A Big 'Bellyache'

REX H. WILSON, MD, Medical Director, B. F. Goodrich Co

Recent publicity has made ileitis a public byword. Its cause is unknown. It is a recurrent inflammation usually involving the terminal end of the small bowel. The bowel becomes ulcerated and inflamed and eventually becomes scarred, narrowed, and obstructed. Usually only one portion of the intestine, but sometimes several different segments, may be involved. The bowel wall may perforate because it is weakened and cause an abdominal abscess or an infected fistula.

Ileitis is often confused with appendicitis. There is pain in the right lower abdomen in both diseases. Most cases of ileitis are accompanied by a bloody mucous diarrhea. Patients with appendicitis usually are constipated. Fever, loss of appetite, weakness, and a feeling of depression are symptoms of ileitis. In the later stages a mass may be felt in the abdomen. Many cases of ileitis have anal infections. Serial X-ray pictures will usually disclose the regional diseased small bowel.

Ileitis occurs frequently in those who are susceptible to nervous and emotional stresses and strains. A medical cure is rare. Many cases subside spontaneously. The patient may become a chronic invalid. The disease progresses slowly and rarely threatens life. The preferable medical treatment is one adapted to the needs of the patient. Most patients, because of poor digestive functions, suffer from malnutrition. A non-roughage diet, vitamins, blood transfusions, minerals, and the use of certain of the sulfonamides and the antibiotics are all used. X-ray therapy helps some.

Many cases will require surgery. The diseased portion of the bowel is bypassed, the diseased portion is removed. Sometimes the short-circuiting operation is done first, the diseased bowel removed later. About 10 to 15% of cases of regional ileitis recur after surgery. Several years of good health may intervene. The precipitating factor usually is some disease such as a respiratory infection. Treatment of recurrences may be medical or surgical. The patient with ileitis requires medical observation and at least moderate treatment for life.

When you have a pain in your abdomen the possibility of appendicitis or regional ileitis is present. Severe persistent pain in your abdomen is sufficient reason for you to consult with your physician

WASHINGTON COMMENT

Public Power Groups Eye Utility Advertising

ECAP officials testify before House Appropriations Committee; closed session, called on "flimsiest excuses," raises questions on future developments

V. CRAIG RICHTER, Washington Correspondent

The public power forces in Washington have long sought some way of curbing electric utility advertising. This subject has been the cause of innumerable resolutions to Congress over the past few years. In view of this, it is a good assumption that these public power groups had more to do with the recent inquiry into the Electric Companies Advertising Program "atomic power" advertisement than is apparent on the surface.

The House Appropriations Committee called for the hearing into the ad which appeared in a large number of big city newspapers (EW, June 25, p 102). "Invited" to testify at the hearings were representatives of N. W. Ayer & Son, Inc, the ECAP advertising agency. This invitation was backed up by subpoenas, issuance of which the committee had authorized earlier on a 22 to 12 vote. The excuse given for the hearing was that the ad was misleading the American public by painting a too optimistic picture of U. S. atomic power progress.

Subsequent to the invitation to N. W. Ayer to testify, a similar invitation was issued to the St. Louis Post Dispatch because of an editorial it had run on the subject. The Dispatch editorial policy generally has taken the line that the U.S. atomic power program was lagging seriously. But the newspaper promptly declined the invitation and told Chairman Clarence Cannon (D-Mo.) the committee had no right to inquire into its editorial policy and source of its information. Cannon did not pursue the matter any further. It might have been well if the N. W. Ayer spokesmen and private utilities executives had been as bold. Instead industry people let the "executive session" device of the committee close their mouths against Cannon's original attack.

The one-day hearing was a closed affair and apparently has been completed. But it raises several questions and observations:

1. How could an appropriations committee justify, unless its motives were purely political, a hearing of this nature which had nothing directly to do with pending legislation or appropriations?

2. The substance of the advertisement was taken right out of testimony before the Joint Atomic Energy Committee on the Gore reactor bill. If there were any questions to be asked, surely this should have been the appropriate group to do so?

3. What is going to be done with the record and report of the one-day hearing? The tactics of the Chudoff committee in its federal power policy hearings come to mind. Will the Cannon committee also use its report when it is politically convenient to do so? The next few months will answer this question. As the matter stands now, the committee says it will release its report at "some date in the future."

It is obvious that the Cannon committee hearing was called on the flimsiest of excuses. And it demonstrates again that the electric utilities are still the favorite whipping boy of some politicians.

TECHNICAL NOTES

Bundled conductors reduce the reactance of 345-kv transmission lines at a fourth of the cost of series capacitors.

Wind power can be firmed up by applying its generation to electrolyze water. Hydrogen obtained in this way is stored for firing a gas-turbine generator which feeds utility load while the oxygen is a salable by-product.

Staged fault tests at varied locations on a transmission line can be simulated by applying all faults at one accessible point and adjusting relay settings to give indication of the fault at other points under study.

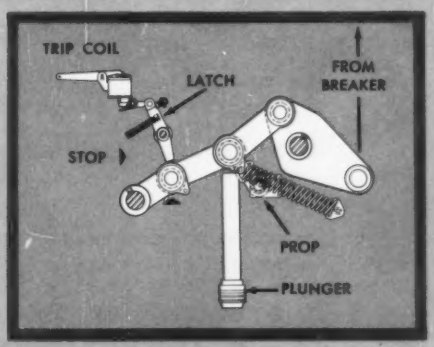
Safe voltage for portable tools is sought by the British in an official proposal of 55/110-v supply with center tap grounded. Dissenters challenge 55 v as too high, suggest a 25-v limit.

Stacking feedwater heating stages in a compact tower shell can save $10 to $15 per kw of powerplant capacity.

You Get MORE Positive Protection

with Allis-Chalmers Mechanically Trip-Free Breakers

This 115-kv Allis-Chalmers breaker in eastern utility substation features Mechanically Trip-Free *Pneu-Draulic* operator.



Simple uncoupling linkage permits contacts to open regardless of position of closing mechanism.

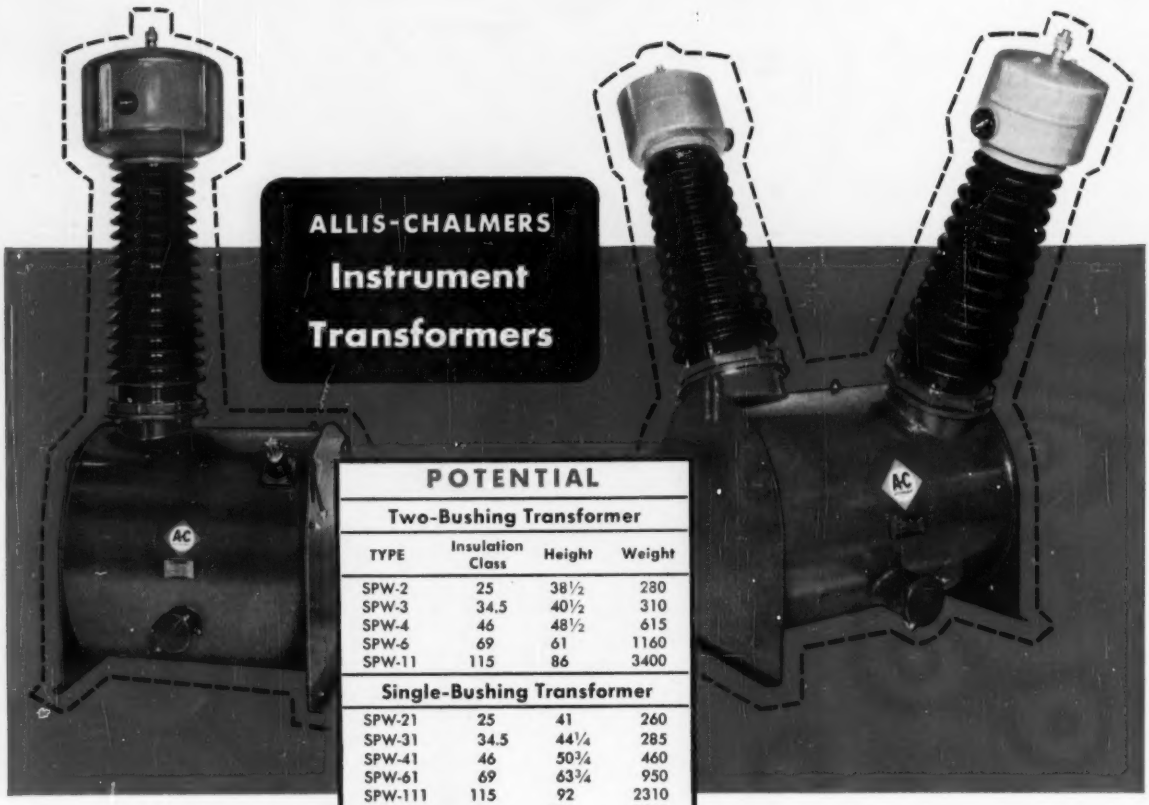
● Only Allis-Chalmers power circuit breakers open at full speed under all conditions . . . because only Allis-Chalmers builds *all* breakers fully Mechanically Trip-Free. *Pneumatically or hydraulically trip-free breakers cannot give you this protection.*

For details of this and other features, such as the *Pneu-Draulic* operator and the completely tested *Turbo Jet* interrupter, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Pneu-Draulic and *Turbo Jet* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

A-4981



POTENTIAL			
Two-Bushing Transformer			
TYPE	Insulation Class	Height	Weight
SPW-2	25	38½	280
SPW-3	34.5	40½	310
SPW-4	46	48½	615
SPW-6	69	61	1160
SPW-11	115	86	3400
Single-Bushing Transformer			
SPW-21	25	41	260
SPW-31	34.5	44¼	285
SPW-41	46	50¾	460
SPW-61	69	63¾	950
SPW-111	115	92	2310
SPW-131	138	112	3510

Advanced Design Features Mean...

Savings in Size and Weight

Now, reductions in size and weight make Allis-Chalmers potential transformers easier to handle — simplify installation procedures.

Compact Design results in improved performance in both ratio and phase angle.

New Ratings. This line of potential transformers has also been expanded to include higher voltage insulation classes.

Advanced Corona-Free Design principles enable these transformers to withstand long continued voltage stresses and short-time surge conditions. Internal corners and coil edges are protected by formed insulating channels which fit close to coil surfaces —effectively prohibiting formation of corona and the development of leakage paths.

Maintenance-Cutting Construction Features are incorporated, such as all-welded, hermetically sealed tanks to extend life of coils and insulation. The new one-piece high voltage porcelain bushing incorporates the same corona-free design features that are used in the transformer, thus assuring long trouble-free life.

Get All the Facts on these modern, lightweight transformers. Contact your nearby Allis-Chalmers district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for more information.

LIVE BETTER ELECTRICALLY

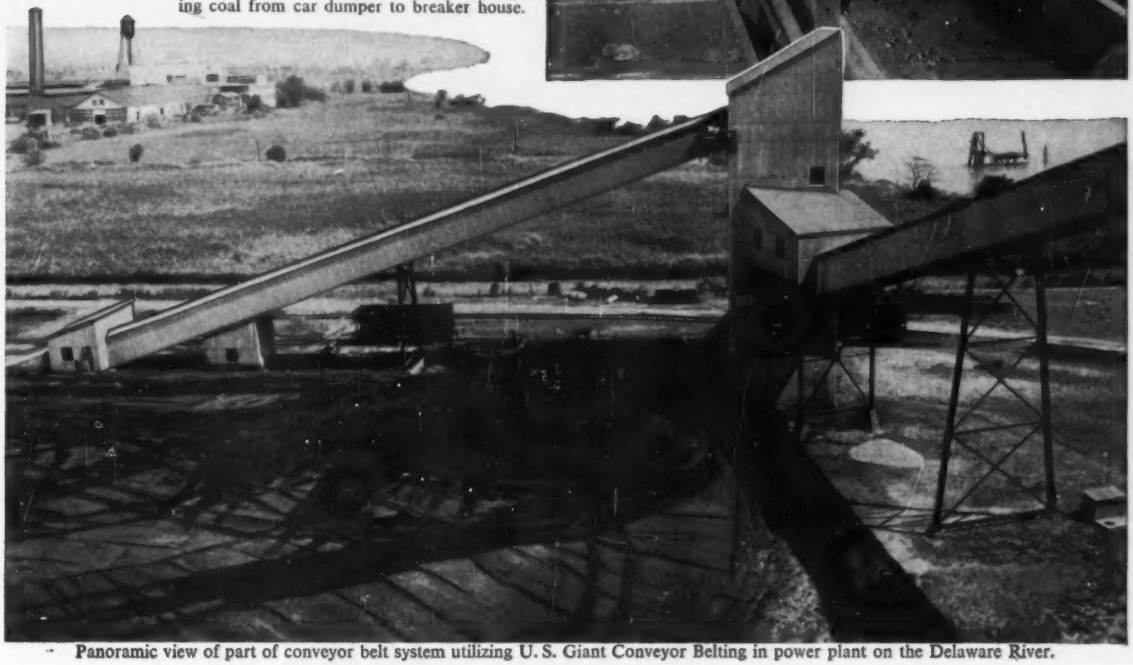
ALLIS-CHALMERS

AC ALLIS-CHALMERS

A-5087

Carrying coal in Delaware Valley with U.S. Rubber Conveyor Belts

(at right) U. S. Giant® Conveyor Belt, carrying coal from car dumper to breaker house.

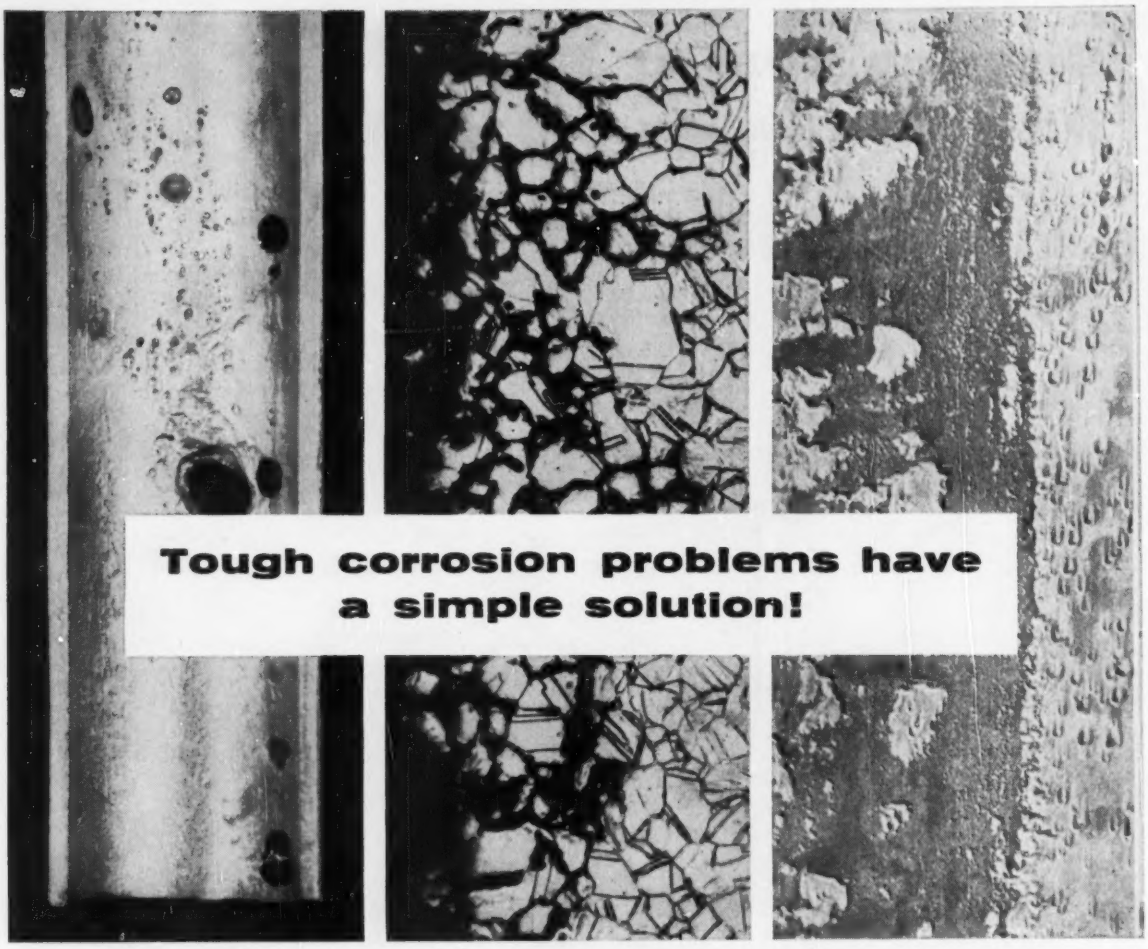


Panoramic view of part of conveyor belt system utilizing U. S. Giant Conveyor Belting in power plant on the Delaware River.

To feed the four boilers in this power plant in the Delaware Valley, United States Rubber Company conveyor belts, capable of handling 300 tons of coal an hour, take the coal from hopper cars to breaker house to coal bunkers. Like so many other successful belting installations, this one is the result of United States Rubber Company's "Three-Way Engineering" —in which "U. S." engineers work with the engineers of the conveyor system and the power company engineers to turn out the most durable, economical belt system for the specific job. In America and abroad there are thousands of "Three-Way Engineered" jobs, some large, some small —but all steadily keeping output high, costs low. Get in touch with any of the 28 "U. S." District Sales Offices, or write to us at Rockefeller Center, New York 20, N. Y.

Mechanical Goods Division

United States Rubber



Tough corrosion problems have a simple solution!

Dezincification

Since 1935, when it was first introduced by Chase, there has *never* been a reported dezincification failure of Chase Antimonial Admiralty tube—and over one-hundred and twenty million pounds have been installed in heat exchangers and condensers!

Intercrystalline Corrosion

Both Chase Antimonial and Chase Cupro-Nickel are highly resistant to intercrystalline corrosion. Alloying elements are properly distributed, grain size carefully controlled, internal stresses minimized—throughout every length of tube!

Impingement

Even turbulent, high-velocity salt water flow is stymied from destructive cavitation in Chase Cupro-Nickel tube. This alloy forms a tough protective oxide film on its surface that strongly resists those horseshoe-shaped impingement pits!

Get full details on *all* Chase heat exchanger and condenser tube alloys.
Write for Free 54-page manual: CHASE Condenser and Heat Exchanger Tubes!

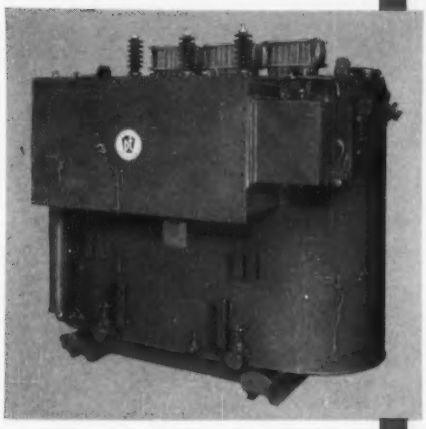
Chase

BRASS & COPPER CO.

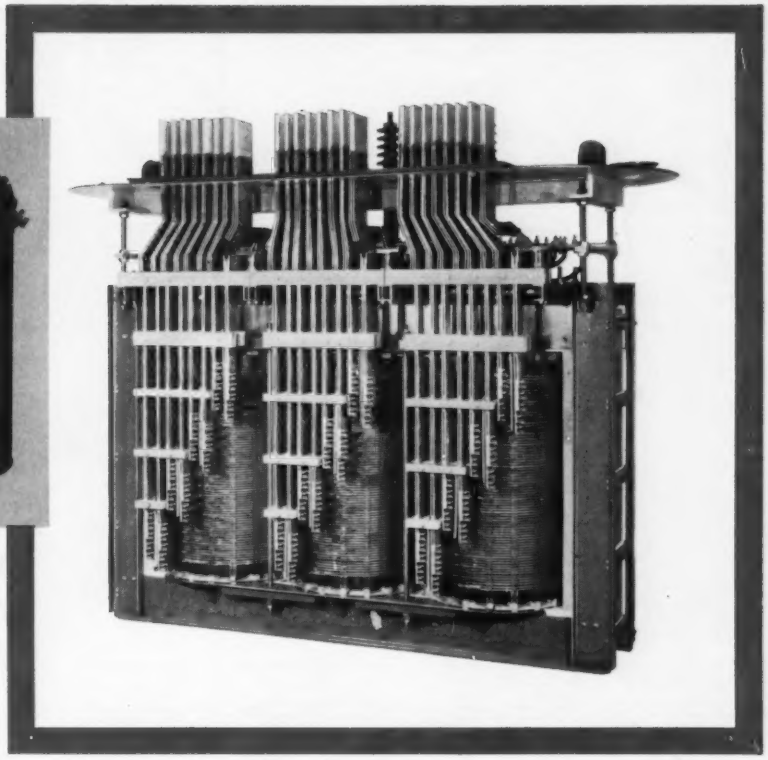
WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury



20,000-kva Pennsylvania Furnace Transformer. Three phase, 60 cycles, water-cooled. High voltage: 24,000 volts. Low voltage: 375 to 250 volts.



JUST 50 DAYS from order to shipment!

20,000 Kva PENNSYLVANIA FURNACE TRANSFORMER

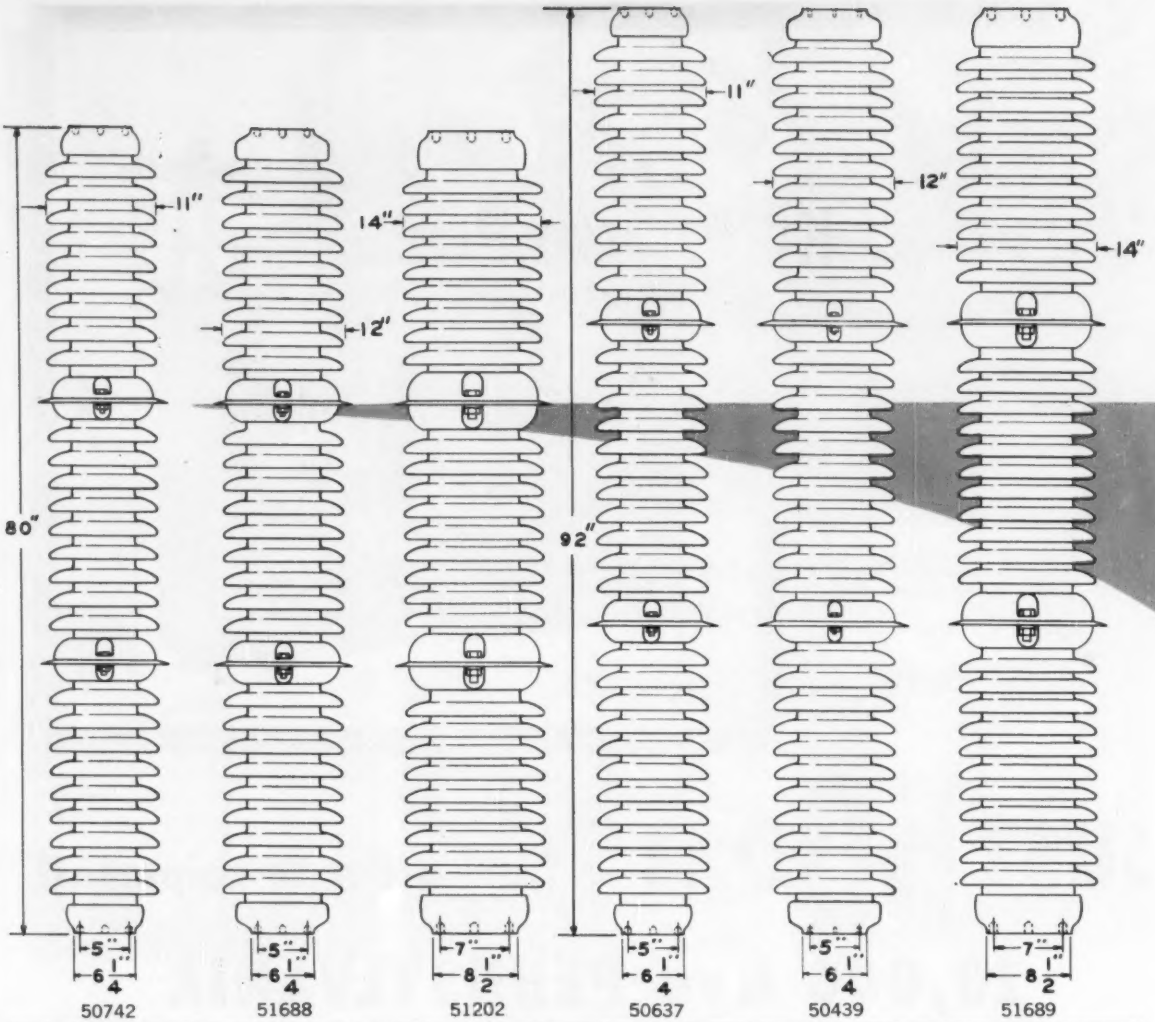
Such speedy production of a furnace transformer of this size provides a striking demonstration of Pennsylvania Transformer Company's experience — and ability — in the highly challenging field of furnace transformer design and manufacture. In the case of this 20,000-kva unit, there were certain limiting dimensions to be met . . . low voltage bus work was required to match existing facilities . . . accessories and auxiliary equipment had to be located on the high voltage side or ends of the tank.

Working with transformer-design know-how dating back about half-a-century, Pennsylvania was able to meet these specific requirements, build and ship the much-needed transformer in exactly 50 days from the date the order was entered on the books. A feature of the unit is Pennsylvania's *exclusive helical low voltage winding* — which, since its introduction in 1936, has a record of *no breakdowns for more than 20 years.*

Other points worth noting are the separate, external compartments for the motor-operated tap changer and the tap-changer controls . . . and provisions for future forced-oil cooling with water-cooled heat exchangers.

Do you have a furnace transformer problem? Whether it involves short-term delivery or special design requirements, Pennsylvania will welcome the opportunity to serve you.

PENNSYLVANIA TRANSFORMER COMPANY
A McGraw Electric Company Division CANONSBURG, PA. Greater Pittsburgh District



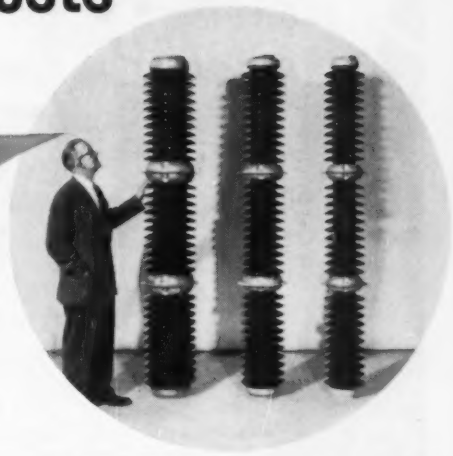
50742 51688 51202 50637 50439 51689

Catalog Number	50742	51688	51202	50637	50439	51689
Voltage Rating, Kv	196/230	196/230	196/230	230/287	230/287	230/287
Cantilever Strength, lbs.	910	1450	2750	750	1170	2300
Tension Strength, lbs.	20,000	25,000	40,000	20,000	25,000	40,000
Torsion Strength, inch-lbs.	40,000	90,000	120,000	40,000	90,000	120,000
Compression Strength, lbs.	60,000	75,000	100,000	60,000	75,000	100,000
60-Cycle Dry FO, Kv	575	575	575	660	660	660
60-cycle Wet FO, Kv	475	475	475	570	570	570
Impulse Flashover, Kv Pos.	1010	1010	1010	1210	1210	1210
Impulse Flashover, Kv Neg.	1240	1240	1240	1450	1450	1450
60-cycle Withstand, Kv Dry	465	465	465	545	545	545
60-cycle Withstand, Kv Wet	385	385	385	455	455	455
Impulse Withstand, Kv	900	900	900	1050	1050	1050
Test Voltage, Radio Infl.	125	125	125	146	146	146
Maximum RIV, Microvolts	500	500	500	500	500	500
Leakage Distance, in.	165	165	165	198	198	198
Dry Arcing Distance, in.	64	64	64	76	76	76
Net Weight, lbs.	310	370	580	360	430	645

ANNOUNCING

Lapp 230 Kv Station Posts

IN 3 STRENGTH RATINGS
...IN 2 BIL WITHSTAND RATINGS



To designers of stations at 230 Kv, Lapp offers its proved Station Post in two BIL series . . . 900 Kv withstand and 1050 Kv withstand . . . in standard strength, high strength, and in new extra-high strength that possess cantilever values greater than those of any switch and bus insulators ever offered before at this voltage.

EASIER, FASTER TO INSTALL Lapp high-voltage Station Posts cost less to assemble and handle than do conventional pin-cap stacks for switch and bus use. They weigh less and are composed of fewer sections. Stack for stack, a comparison with available conventional station insulators shows the Lapp Station Posts to be approximately 30% lighter in weight.

All Lapp 230 Kv Station Posts consist of three sections, each with caps cemented at the ends, and bolted together with four hex-head bolts. A total of eight bolts completes the assembly. End caps have standard bolt circles, require no sub-bases, spacers or adapters.

LAPP POSTS ARE *STIFFER* The Lapp Station Post unit is a one-piece porcelain post with caps cemented at the ends in large area, low tension compression grip . . . as compared to the nested porcelain shells and internal pin of conventional stacking units. Under cantilever load, deflection of Lapp Posts is considerably less than that of conventional pin-cap insulators; laboratory measurement shows the reduction in deflection to be approximately 50%. This increase in rigidity overcomes the serious problem of switch alignment commonly encountered by operators of 230 Kv substations.

STATION POST PERFORMANCE In addition, these insulators provide all the well-known advantages of Lapp Station Post design . . . porcelain cracking or puncture is eliminated because the hardware is on the outside . . . freedom from radio interference without need for conductive coatings . . . better service and lower maintenance cost under dirt conditions . . . greater resistance to arcover and mechanical attack.

At 230 Kv too, Lapp Station Posts provide an *extra* margin of operating security, low upkeep and long life.

Lapp Insulator Co., Inc., Le Roy, N. Y.

Lapp

25 KVA
distribution transformer

5000 KVA, 3-phase
oil-immersed power transformer

★ Important reason why every CENTRAL TRANSFORMER is of consistent high quality . . . why longer life, uninterrupted performance is assured

Each detail in the manufacture of Central transformers is checked and double-checked against rigid specifications. Not until the chief inspector's final OK is stamped on the tag, is a Central transformer ready for delivery.

It is this exacting inspection, plus careful engineering, finest materials, skilled workers and a modern plant that has won for Central a reputation for the design and manufacture of transformers unexcelled anywhere.

No wonder more and more firms are looking to Central for precision-built transformers. Why don't you discover how Central can serve you?

A type for every need . . . from the smallest to the largest

CTC NEMA **Central** TRANSFORMER CORP.

PINE BLUFF, ARKANSAS
Sales Offices in principal cities.

DESIGNERS AND MANUFACTURERS OF TRANSFORMERS ONLY

IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

NEW INSULPRENE

OIL RESISTANT • WATER RESISTANT • IMPACT RESISTANT

Twist-Lock®

Strongest, toughest, most wear-resistant Rubber Connector ever produced.

CAT. NO. **9966**
3 WIRE

20 Amp. 250 Volts (AC or DC)
10 Amp. 600 Volts (AC only)

IT'S RUGGED!

1. A tough fibre disc has been molded into the INSULPRENE 1/8" from the face to insure positive polarity and anchor the blades securely in position, thus preventing accidental pull-out.

2. Blade slots in the disc, accurately die-stamped, prevent incorrect insertion of blades even when extreme pressure is applied.

3. #8 screws with extra large heads simplify wiring and provide a secure connection.

4. Fibre retaining piece anchors terminal plates and seals off wiring area from lint and dust.

5. Powerful Hubbell cord grips eliminate tension from the terminals.

6. Extra rugged terminal plates of 1/8" brass.

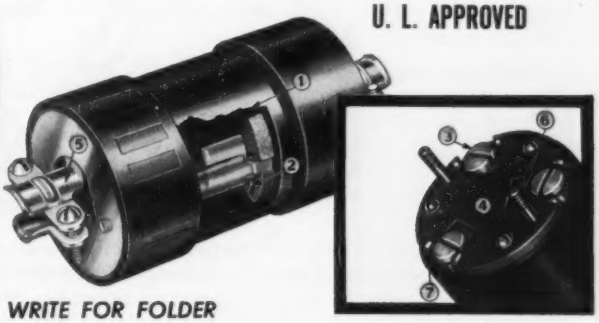
7. Double wire lugs on each terminal plate effectively confine wire strands.

8. Will accommodate same caps used with regular Twist-Lock units.

This new series of rubber Twist-Lock Connector Bodies is molded from an exceptionally tough neoprene composition prepared especially for Hubbell. Because of its excellent insulating properties and outdoor aging characteristics, this new material has been named Hubbell **Insulprene.** It has a high impact resistance enabling it to stand up under the roughest abuse and, in addition, it resists oil, hot water, live steam, grease, fatty acids.

Insulprene Twist-Lock Units, available in 2-wire, 3-wire and 4-wire sizes, are among the safest, most secure and long-lived Twist-Lock Connectors ever produced. Designed to withstand rough industrial or commercial service, they are ideally suited for welding shops, paint-spray rooms, heat-treating departments, bakeries, laundries, car-wash establishments, drive-in theatres.

U. L. APPROVED



WRITE FOR FOLDER

Buy them from your nearest electrical wholesaler

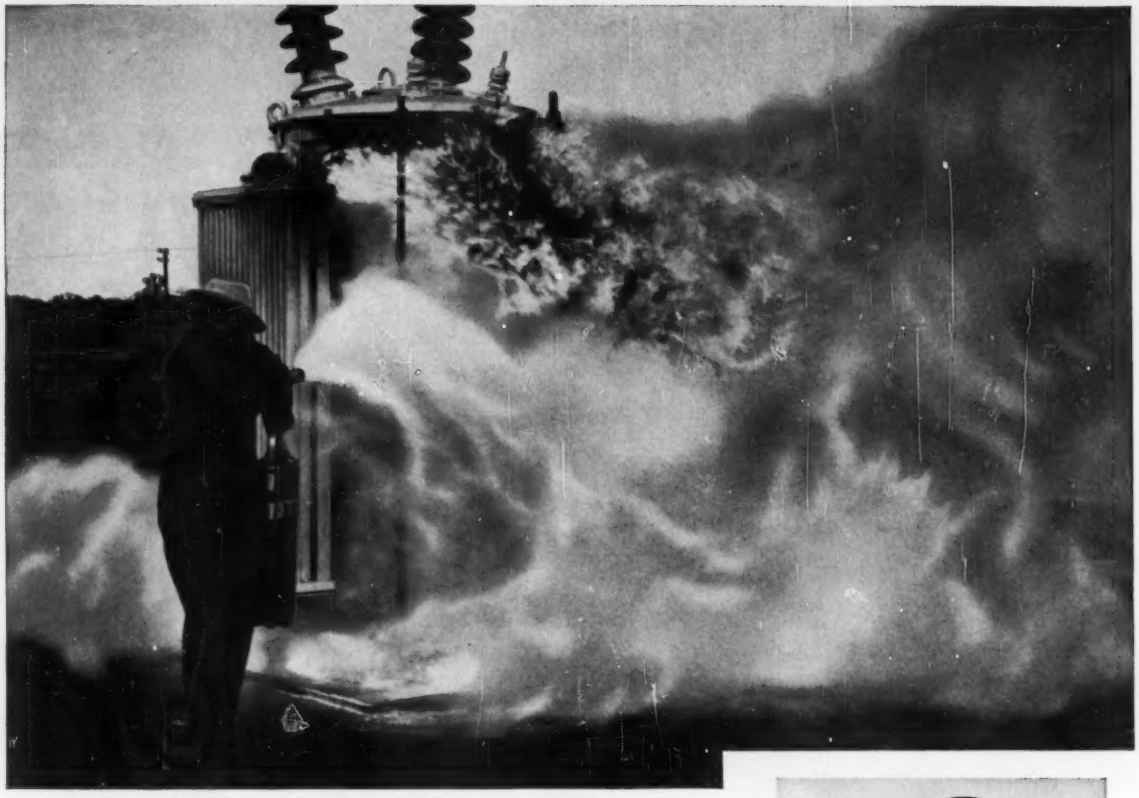
Harvey Hubbell, INC.

DEPT. E-2 **BRIDGEPORT, CONNECTICUT**

FACTORY WAREHOUSE LOCATIONS ASSURE NATIONWIDE STOCK AVAILABILITY

State and Bostwick Sts. Bridgeport 2, Conn. | 37 South Sangamon St. Chicago 7, Ill. | 103 North Santa Fe Ave. Los Angeles 13, Calif. | 1675 Hudson Ave. San Francisco, Calif. | 1111 Dragon St. Dallas 7, Texas

TRANSFORMER FIRE!



KIDDE DRY CHEMICAL SNUFFS IT FAST!

Ready, aim . . . and the most stubborn fire's out . . . stopped in its tracks by the *extra* fire-killing power of Kidde Dry Chemical Extinguishers!

Light in weight (to let you move fast and aim quickly), these exceptional dry chemical extinguishers feature Kidde's patented diffuser horn which gives you up to *44% more* fire-fighting coverage than ordinary dry chemical extinguishers. This feature, plus Kidde's fast-acting trigger-finger grip, lets even inexperienced operators fight severe fires calmly, quickly and without danger.

In addition, the Kidde dry chemical line offers you variety of models and capacities. Cartridge-operated Kidde dry chemical extinguishers come in 20 and 30-pound capacities, while the pressurized dry chemical models are available in capacities of 5 and 10 pounds. All Kidde pressurized extinguishers have easy-to-read, dustproof pressure gauges, can be charged to U.L.-approved working pressures (150 pounds) at any commercial air pump. In addition, the 10-pound model can be charged to 250 pounds for extra fire-fighting punch! It is U.L.-approved at either pressure.

For more information on the complete Kidde Dry Chemical line, write today for Kidde's P-8 Extinguisher Catalog.

Kidde 20-pound dry chemical portable

Kidde

Walter Kidde & Company, Inc.
730 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd.
Montreal—Toronto

SERVICE WEDGE CLAMPS

demonstrate that

the PROOF of a product is in

EXPERIENCE

EXPERIENCE in manufacturing

EXPERIENCE with use

When a manufacturer makes, and his customers use literally millions of his product, EXPERIENCE obviously indicates that the product is right. The valuable experience gained in manufacturing so many wedge type clamps means that utilities can buy and use them with confidence in their performance, their safety and their cost.

Reliable started with the telephone drop wire clamp, then came the concentric cable clamp and a little later the Service Wedge Clamp. Utilities from coast to coast know from experience that Reliable Service Wedge Clamps in a wide choice of types and sizes meet *all* their requirements.

FOR SERVICE DROP CABLES

Reliable offers 27 catalog numbers to provide the widest range of sizes and types in the industry.

Specify and be sure to get the product that experience has proved best . . . Reliable Service Wedge Clamp.

Reliable

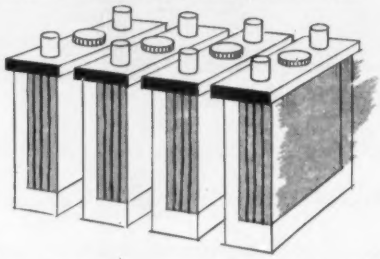
POWER LINE CONNECTORS AND CONSTRUCTION SPECIALTIES

ELECTRIC COMPANY

3145 CARROLL AVENUE
CHICAGO 12, ILLINOIS

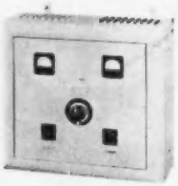
OVER 45 YEARS OF SERVICE TO THE UTILITIES

make reserve power positive power



It's common practice to depend on storage batteries whenever *power must not fail.* But, dependable as storage batteries are, you have to be sure they are *ready* to deliver power at a moment's notice . . . any time. Your best insurance of such readiness is an INET-Palmer *Regulated* Battery Charger. Completely unattended, they guard your reserve batteries against sulfation and discharge . . . make sure 24 hours a day that standby power, on those once-a-year occasions when it's needed, is ready for immediate use.

6 reasons why your best buy is an INET-Palmer *regulated* charger...



COMPLETELY AUTOMATIC . . . operates unattended; no operator required.

DEPENDABLE . . . no moving parts or vacuum tubes used in circuits.

STABLE . . . less than ±1% variation from no-load to full-load despite ±10% simultaneous input variation.

EASY INSTALLATION . . . floor (right), wall (left), or panel models available.

WIDE RATING RANGE . . . 3 to 60 cells in ratings to 50 KW.

LOW OPERATING COST . . . nothing to wear out, nothing to maintain.

LEACH CORPORATION / INET-PALMER DIVISION

Write for Bulletin T-1100. It gives pictures, ratings, sizes, descriptions of the complete INET-Palmer Charger line. Write for it today.

4441 SOUTH SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA

DISTRICT OFFICES AND REPRESENTATIVES IN PRINCIPAL CITIES OF U. S. AND CANADA

Although Circle is one of the country's largest producers of building wire and cable, customers can still call headquarters direct for immediate personal attention.

WHY CIRCLE CAN "TURN HANDSPRINGS"

on shipments needed yesterday!

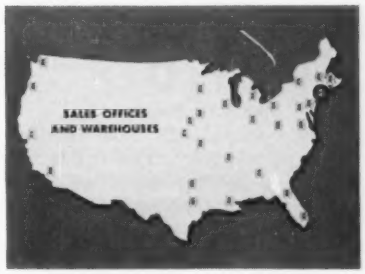
Your Circle distributor doesn't have to build any fires under us to get fast action on building wire and cable you need in a hurry.

That's because giving this kind of fast service is a basic policy of Circle's—the result of a flexible organization that's out of sympathy with "red tape," "stuffed shirts," and routine treatment of emergency orders.

When a Circle distributor wires or phones to ask for a shipment "needed yesterday," he knows he can get to anyone from the president on down—and get immediate personal attention.

Chances are, however, he rarely finds himself in that kind of a spot. His own ample stocks of top-quality Circle wire and cable are backed by a nearby completely-stocked Circle warehouse—*one of twenty-two* strategically located across the country.

That is why working through a Circle distributor is always your best assurance of adequate supplies—quickly and dependably delivered to the site. Circle Wire & Cable Corp., 5500 Maspeth Ave., Maspeth, Long Island, N. Y.



Circle maintains a national network of 22 well-stocked warehouses to help your distributor provide fast local deliveries of top-quality building wire and cable.

C W C **CIRCLE**

WIRE & CABLE
a subsidiary of
Cerro de Pasco Corporation

PLANTS: Maspeth and Hicksville, N.Y. **SALES OFFICES & WAREHOUSES:** Atlanta, Baltimore, Boston, Chicago, Cincinnati, Dallas, Des Moines, Detroit, Houston, Jacksonville, Los Angeles, Miami, Minneapolis, Nashville, New Orleans, Omaha, Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Seattle, St. Louis. **ADDITIONAL SALES OFFICES:** Cleveland, Davenport, Ia., Newark, New Haven, New York, Utica.

RUBBER COVERED WIRES & CABLES · VARNISHED CAMBRIC CABLES · PLASTIC INSULATED CABLES · NEOPRENE SHEATHED CABLES

Standard® TRANSFORMERS

in good company

Standard Transformers have a reputation for keeping company in the best circles, both here and abroad. Standard designs and builds many of its transformers to meet specific requirements, incorporating those components specifically requested by the customer. These custom transformers cost no more than repetitive models and in many cases, because they are custom built, cut costs all the way along the line.

When you ask for bids, or when you place your next order for transformers, include Standard. You'll be following the lead of many outstanding power companies. If you have a specific transformer engineering problem, refer it to Standard. It will receive prompt attention.

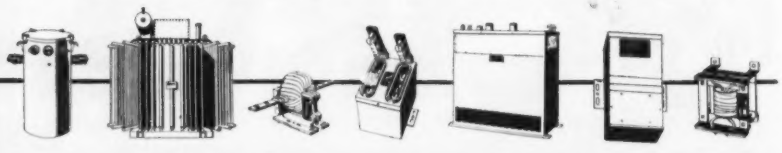
Standard®

THE STANDARD TRANSFORMER COMPANY

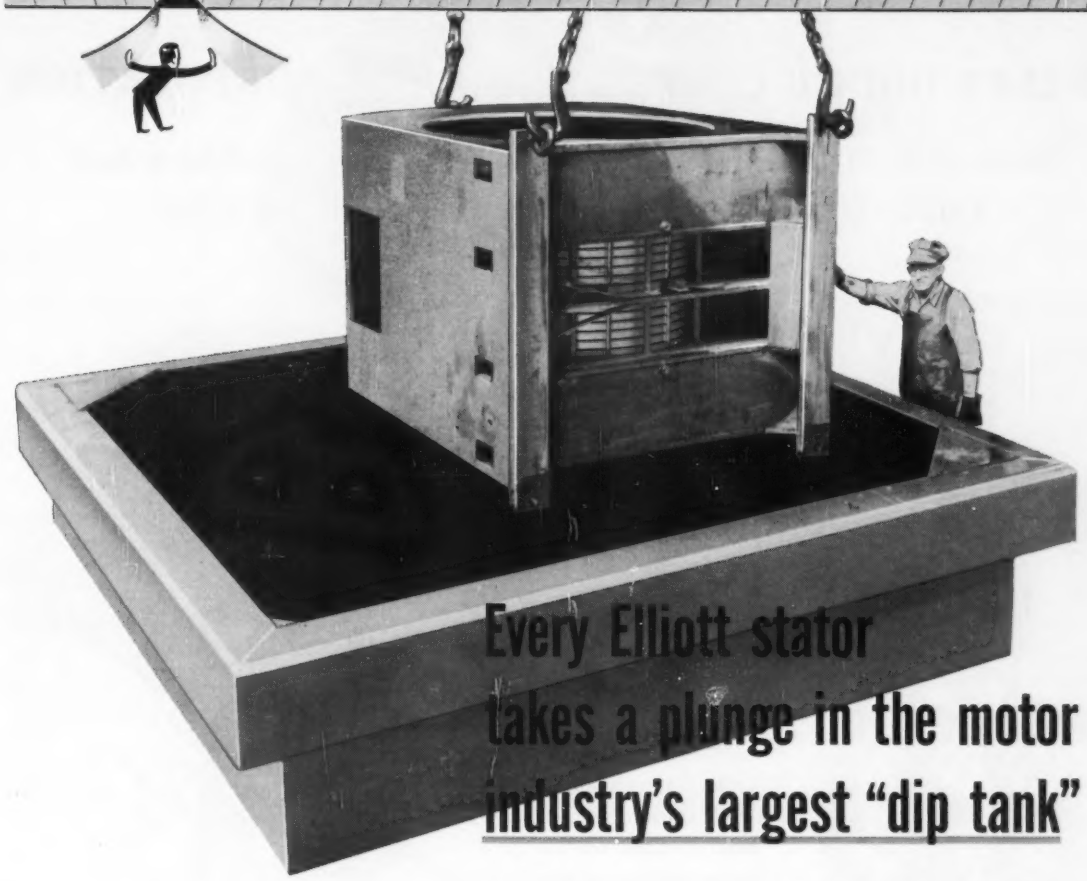
WARREN, OHIO • REPRESENTATIVES IN PRINCIPAL CITIES

Transformers

FOR EVERY APPLICATION

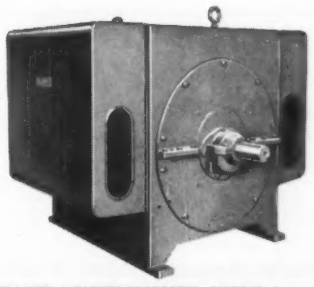


LOOK BEHIND THE "INSULATION CURTAIN" BEFORE YOU SELECT A LARGE MOTOR



Every Elliott stator takes a plunge in the motor industry's largest "dip tank"

Here is another reason why Elliott Induction Motor coil insulation has proven so successful. *Every large induction motor stator, regardless of size,* is completely submerged in specially selected flexible varnish. This completely saturates the stator winding and provides an additional rust-inhibiting coating to metal parts. After baking to a prescribed process, the coil end turns, leads and joints are given two subsequent dips and bakes. This provides additional assurance against the entrance of moisture, chemical fumes, dust, etc. This is a big plus in the long list of Elliott "extras" in insulation that have contributed to an outstanding record of *not one failure due to insulation* in over 1,400,000 hp of large squirrel-cage induction motors installed through the country during the last 7 years. These motors are serving all over, both indoors and out – in utilities, oil refineries, chemical plants, metal mills, atomic energy plants, shipyards, paper mills, etc. For full facts, ask your Elliott field engineer or write Elliott Company, Ridgway Division, Ridgway, Pa.



ELLIOTT WEATHER-PROTECTED MOTORS have a perfect seven year success record of no stator failures due to faulty insulation. The only weather-protected motor which can make such a claim.

R6-11

ELLIOTT Company

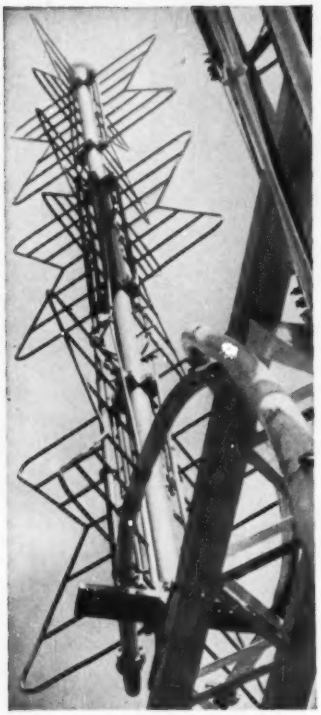
Elliott large motor insulation is "field-proven"

ALUMINUM-SHEATHED CABLES

Pioneered in the U. S. by

PHELPS DODGE COPPER PRODUCTS CORPORATION

Over 600 Miles of Phelps Dodge Aluminum-Sheathed Cable Have Been Put into Service Since 1952!



Phelps Dodge aluminum-sheathed *communication* cables have been installed on a number of major commercial and national defense projects. In addition, the majority of the VHF-TV commercial transmitting antennas in the U. S. are now equipped with these cables.

Phelps Dodge aluminum-sheathed *power* cables have now been installed on the lines of several of the country's leading utilities, both aerially and underground.

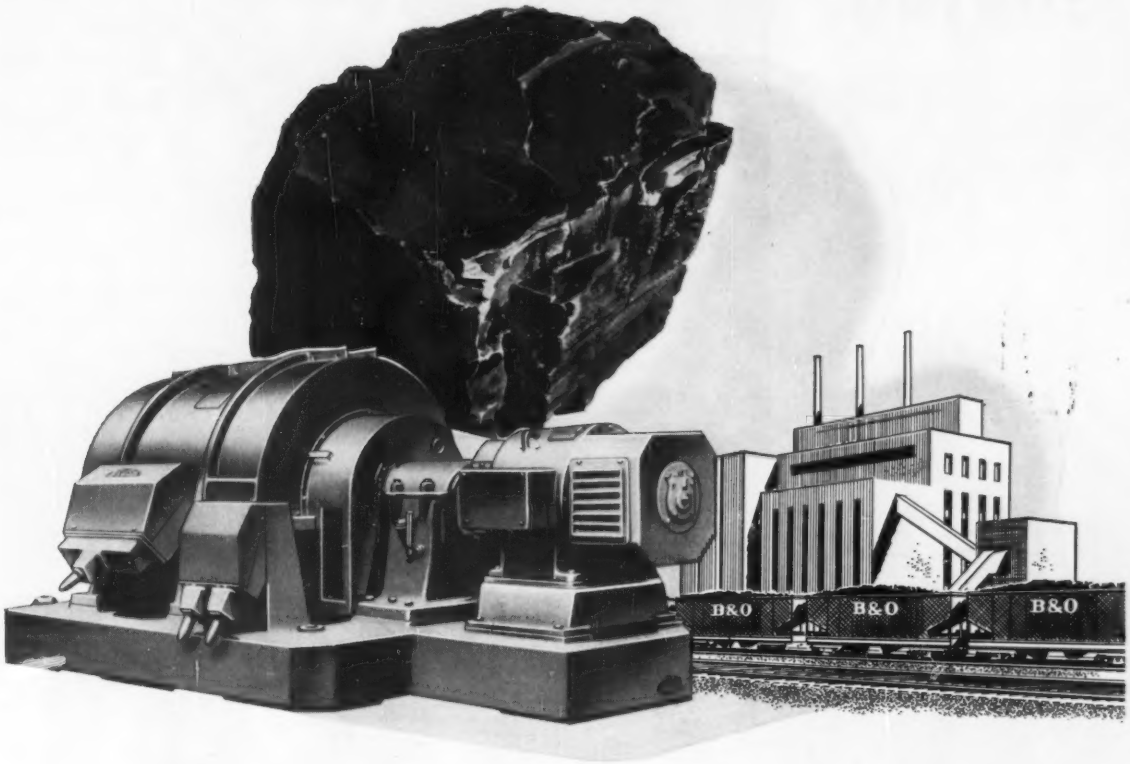
The introduction of aluminum sheathing has opened up great advances in the cable field. Aluminum's lighter weight (permitting longer cable spans) and greater tensile strength are admirably adapted to cable applications of various kinds. Cables can be provided with polyethylene jacket for corrosion protection.

Phelps Dodge's pioneering background, manufacturing skill and thorough engineering "know-how"—the result of four years of experience in this highly specialized field—are unsurpassed.

We welcome your inquiries. Write Dept. ED

PHELPS DODGE COPPER PRODUCTS CORPORATION

300 PARK AVENUE, NEW YORK 22, N. Y.



Energy PRODUCER EXTRAORDINARY!

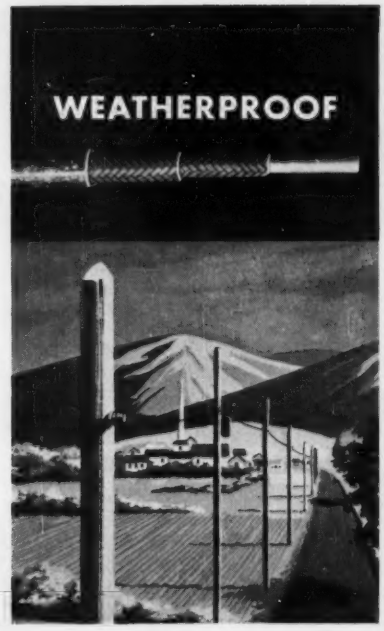
Coal-generated electric power is continually on the increase because Bituminous is economical and abundant. Billions of tons in proved reserves of bituminous for every purpose are available on the B&O. Mines operated with modern efficiency are prepared to provide the right coal for your specific needs. *Ask our man!*

LET OUR COAL TRAFFIC REPRESENTATIVES suggest the B&O bituminous you can bank on. Contact Coal Traffic Department—B&O Railroad, Baltimore 1, Md. LExington 9-0400.

BITUMINOUS COALS FOR EVERY PURPOSE

BALTIMORE & OHIO RAILROAD

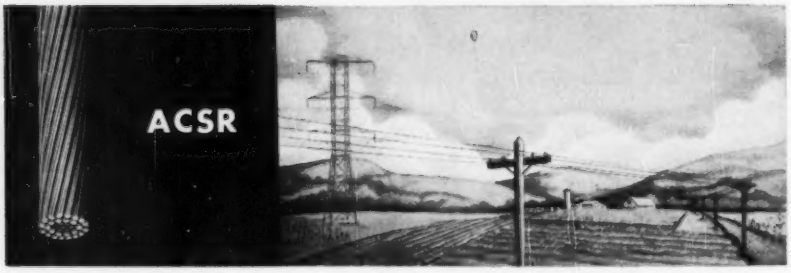
BITUMINOUS COALS FOR EVERY PURPOSE



GENERAL CABLE

ALECTRAL

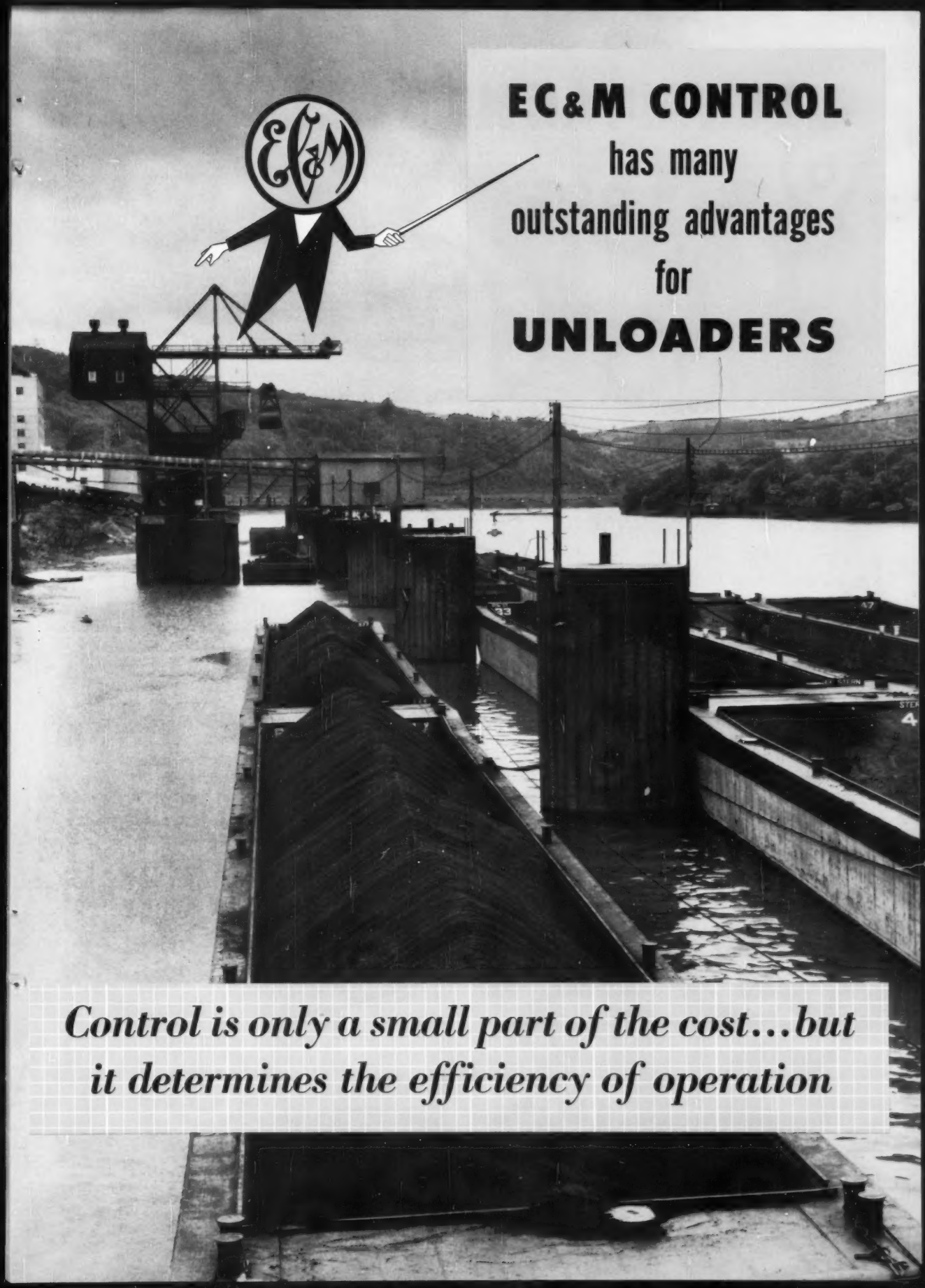
FOR ALL ALUMINUM CONDUCTOR REQUIREMENTS



Built into all ALECTRAL products are 75 years of General Cable's engineering and manufacturing experience. In this record are more than 25 years of successful performance of *insulated* aluminum conductors marketed as ALECTRAL. Available in ALL-ALUMINUM, ACSR, WEATHERPROOF and with RUBBER and THERMOPLASTIC insulations. A sound and economical investment for all voltage ranges.

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N. Y.
Offices and Distribution Centers Coast-to-Coast

For quality and service...SPECIFY GENERAL CABLE

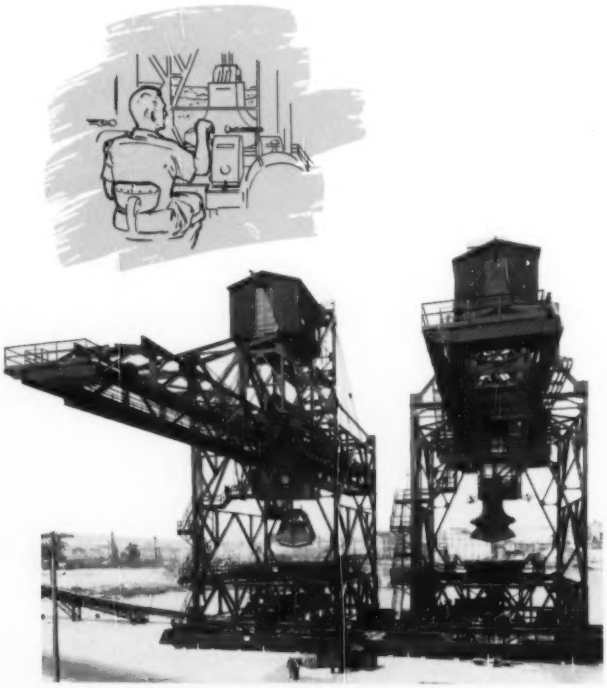

E C & M
EC&M CONTROL
has many
outstanding advantages
for
UNLOADERS
Control is only a small part of the cost...but
it determines the efficiency of operation

EC&M CONTROLLERS . . .

Coal is handled from barge to power plant at an eastern electric generating plant at the rate of 400 tons per hour by this Clyde Unloader equipped with EC&M Control. **Photos — courtesy of Clyde Iron Works, Inc.**

Barges of coal (900 tons per barge) as shown on the preceding page, are unloaded by this 7-Ton Wellman Unloading Tower under EC&M Control at a western Pennsylvania generating plant. **Photos — courtesy of West Penn Power Co.**

On the Ohio River, this McKiernan-Terry Unloading Tower equipped with EC&M Control lifts coal from river barges at the rate of 1200-Tons per hour to supply this generating plant.



Two 15-Ton Dravo Unloaders at the B & O Import Ore Pier at Baltimore, Maryland are completely equipped with EC&M Control. This pier established an eastern seaport record for unloading ocean vessels.

operating from standard voltages . . . are low in cost, safe, simple and easy to operate

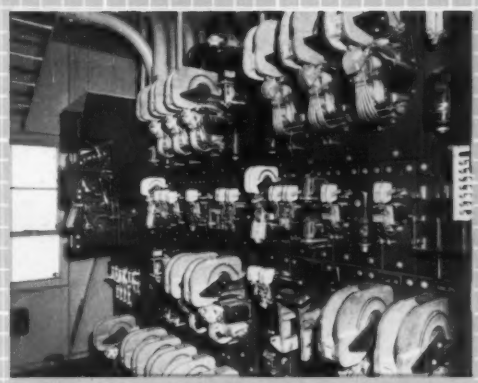
500-ton-per-hour Barge Unloader, designed, fabricated and erected by Heyl & Patterson for the Duquesne Slag Company, Pittsburgh, Pa., and equipped with EC&M Control has been giving excellent results for many years.

Ton by ton . . . EC&M Control helps move bulk materials with an increased output and lower cost that appeal to management. Operators appreciate the smoothness of performance and quick manipulation.

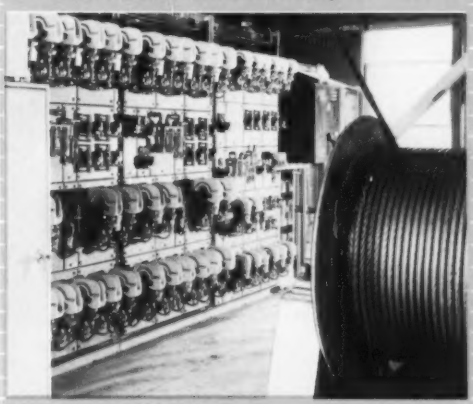
Time-saving advantages of this Control are numerous. Some of these are: facility for paying out cable to dig into the pile, taking the swing out of a loaded bucket at the point of discharge, and keeping the bucket open when lowering for another load.

On river unloading stations, at lake and ocean ports, EC&M Control has earned a reputation for fast lifts . . . safe lifts. To EC&M, each material handling machine is thoroughly investigated . . . the mechanical as well as electrical details, the duty cycle and all important data are considered. From *these facts*, EC&M *accurately engineers* the control for the individual job . . . this results in the greatest service at lowest maintenance. EC&M Control is well-known for reduced manpower and lower renewal part expense. Look at the proof of acceptance of EC&M Control for the wide range of applications shown here.

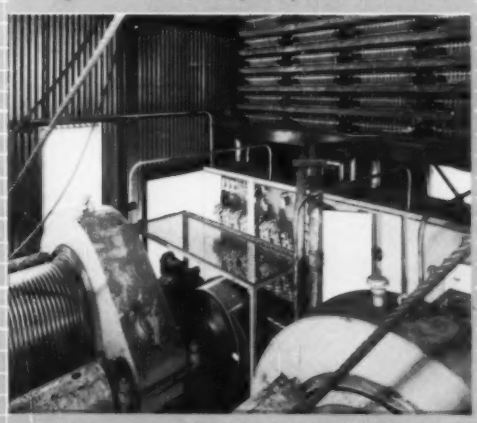
It pays to "SPECIFY EC&M CONTROL"



EC&M D-c TIME-CURRENT Controllers on Dravo Unloaders. All power is brought into the operator's cab on this installation for maximum safety.

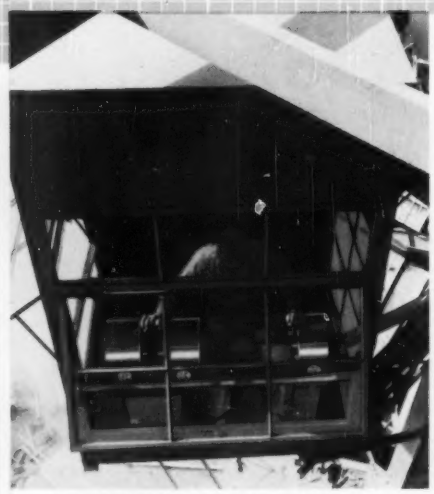


EC&M A-c FREQUENCY-RELAY Controllers provide accurate switching of Closing and Holding Line circuits to give maximum safe torque output of the a-c motor.

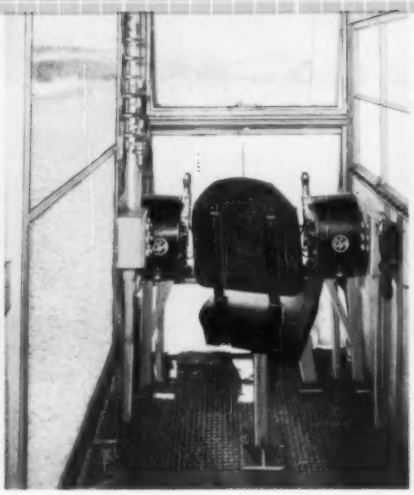


This view shows EC&M Type WB Brake, Frequency Relay Controllers in Cabinets with TAB-WELD Plate Resistors mounted overhead.

Quick Response coordinated with *Safe Operation*



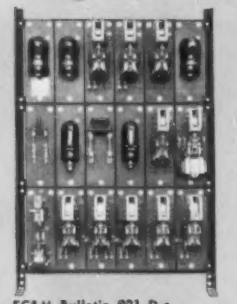
Narrow width EC&M Cam Master Switches are closely grouped for operator's convenience in this cab.



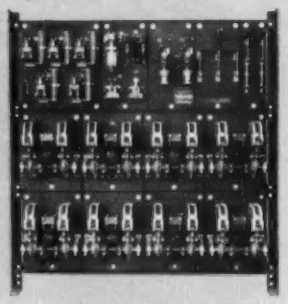
In this narrow cab, EC&M Cam Master Switches require minimum space. This short throw of operating handles contributes to the ease of operation.

Here, the operator controls the Trolley movement through a Foot Master Switch. Hand-operated EC&M Cam Master Switches are used to control the bucket operation.

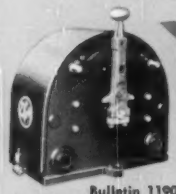
Control Engineered for the Job gives smoother performance



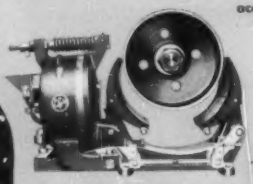
EC&M Bulletin 921 D-c Crane-hoist Controller uses the Wright Circuit for safety, simplicity.



EC&M Bulletin 930 A-c Contra-torque Hoist Controller with Frequency Relays for acceleration, plugging and speed limiting functions.



Bulletin 1190 EC&M Cam Master Switches are narrow in width and have a short throw from full-on to full-off positions.



EC&M Bulletin 1000 WB Brakes give fast release . . . quick set. Are supplied for rectifier-operation on A-c motors.

EC&M Bulletin 942 TAB-WELD Resistors save manpower. No periodic clamping-nut tightening . . . no burning at grid eyes or at tap-plates.

Here's where EC&M Control excels

FAST GETAWAY EC&M uses load-responsive acceleration relays (Time Current on d-c, Frequency Relay on a-c) to provide maximum, safe torque values for efficient unloader operation. These exclusive EC&M Relays provide the fastest, safest acceleration which results in rapid bucket handling . . . fast trolley movement . . . overall reduced time between trips.

WIDE SPEED SELECTION The operator always has at his command a choice of speed-points. And the better speed-range on each point provides greater flexibility for normal operation and during clean-up.

SMOOTHER STOPPING When checking motor lowering speeds, the Resistor values of EC&M Control are *accurately designed* to give quick, safe, smooth stopping of light loads, full loads or the empty bucket. EC&M Acceleration and Plugging Relays automatically govern the rate of acceleration, stopping and reversal of the trolley motion for top performance.

SPEED-LIMITING *Safety* on all Speeds. EC&M High-speed Contactors respond instantly to the Operator's manipulation of the Master Switch; motor connections are switched quickly to conform with the well-known characteristics of EC&M Circuits, which maintain safe lowering and operating conditions at all times.

When buying UNLOADERS, specify EC&M Control

SQUARE D COMPANY

EC & M DIVISION • CLEVELAND 28, OHIO

6976

LITHOGRAPHED IN U.S.A.

Kellogg's Design Calculation Techniques Keep Pace

Latest and most valuable electronic addition to The M. W. Kellogg Company's facilities for solving the design calculation problems of power piping customers is a new, large magnetic drum digital computer. It can execute 500 arithmetical operations per second; conservatively can solve 40 simultaneous equations in 30 minutes; and has a memory capacity of over 4000 ten-digit words. This computer is now in use at Kellogg's new New York Headquarters, and supplements a smaller computer which has been employed for some time at M. W. Kellogg's Jersey City laboratories.

This new computer enables The M. W. Kellogg Company's engineering staff to undertake a far greater number of precise calculations in less time than ever before and, as a result, to determine the optimum main and reheat steam piping designs for steam-electric power plants in minimum time.

A cordial invitation to see the new Datatron computer at work is extended to consulting engineers, and to engineers of power generating companies and their equipment manufacturers. Appointments may be made by contacting the office of the Sales Manager, Fabricated Products Division, The M. W. Kellogg Company, 711 Third Avenue, New York 17, N. Y.

FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY, 711 THIRD AVE., NEW YORK 17, N. Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corporation, London • Societe Kellogg, Paris; Kellogg Pan American Corporation, New York • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

POWER PIPING—THE VITAL LINK

STRONGER THAN THE PIN

In laboratory tests to determine the torsion strength of Kimble *Tempered* Glass Insulators, wood pins were sheared off, and lead-bushed threads stripped, with no failure of the Insulators. Cantilever tests using special alloy pins were discontinued at 10,000 lbs. with still no failure. Ultimate impact tests averaged 130 inch pounds!

Kimble *Tempered* Glass Insulators save installation time because it's never necessary to loosen for lineup with the conductor. Their great strength always allows another quarter-turn.

If it's on the pin, it's in service

Tests far in excess of A.I.E.E. standards have proved it impossible to puncture a Kimble *Tempered* Glass Insulator in air. Even lightning surges have failed to damage them. In the event of shattering due to severe mechanical shock, insulator disintegrates into small, non-sharp fragments. Trouble shooters can locate broken insulator—fast.

What's the secret? *Tempering*, a Kimble development in glass insulators that adds a new element to the many natural virtues of glass insulators. Kimble insulators are more than strong enough to meet the severe tests required.

Why not see how *tempered* glass can cut your line maintenance costs. Write for descriptive folder that gives complete details. Address: Kimble Glass Company, subsidiary of Owens-Illinois, Dept. EW-7, Box 1035, Toledo 1, Ohio.

KIMBLE INSULATORS
AN (O) PRODUCT

OWENS-ILLINOIS
GENERAL OFFICES · TOLEDO 1, OHIO

WHAT

BLACKBURN

HAS

UP

ITS

SLEEVE!

Blackburn Compression Service Entrance Sleeves Feature

- Body of highly conductive aluminum that fits all standard compression tools. Can be used for all combinations of aluminum ACSR and copper conductors.
- Bores of each tube are filled with CONTAX, a mineral base grease with metallic and abrasive particles held in suspension. It has an ASTM drop point of 549° F.—improves conductivity—prevents corrosion.
- Solid metal barrier between bores assures even distribution of CONTAX all around conductors when crimps are made.
- Push conductor through thin wall, color coded caps—no need to remove them before inserting conductor—they do not interfere with installing die. Colors will not run or fade. Sizes cover a wide range of conductor combinations.

Available at Electrical Wholesalers Everywhere.
Wire or write for bulletin on Blackburn Compression Fittings.

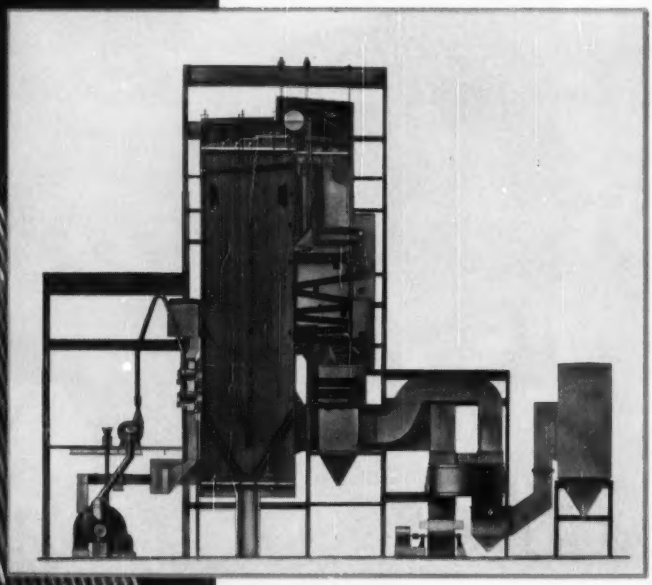
JASPER BLACKBURN CORPORATION 35 MADISON ST. • ST. LOUIS 6, MO. • PHONE MAIN 1-2821

Second "outdoor type" FW steam

LOW LOAD FACTOR

installed at new

Prefabricated at the job site, panel construction of furnace side-waterwalls, radiant superheater and division waterwall made possible significant savings in steam generator construction costs.



Cross-section of Martins Creek No. 2 steam generator, designed for continuous rated capacity of 1,200,000 lbs/hr at 1325 psig normal, 955F. Divided furnace, combination radiant and convection superheater, two continuous loop economizers, weatherproofed outdoor type.

generator, designed for

and QUICK START-UP

Martins Creek Steam Electric Station

Built for "below zero" winter conditions, No. 2 unit raises capability of this modern steam generating plant of Pennsylvania Power & Light Company to 320,000 kw.

UNLIKE most new steam generators that are installed for base load operation, with peak loads being carried on older, less efficient units, the new No. 2 Foster Wheeler steam generator at Martins Creek is intended at the beginning to operate at only 20 to 40 per cent capacity.

Like the No. 1 FW steam generator at this station, it is a peak load unit. It has the requisite control facilities so that it quickly can help meet the early morning demand present in the PP&L system. For these heavy load periods, it provides the desired additional capacity economically, at minimum total annual cost — the major portion of the power being provided by other stations of the system where the delivered fuel cost is appreciably lower.

The eleventh FW unit now serving the Pennsylvania Power & Light Company, this Martins Creek steam generator has an 8-hour-peak capacity of 1,300,000 lbs/hr at 1325 psig, 955F at the superheater outlet. Final steam temperature is held constant at all loads from 325,000 lb per hr to full load. Of the single drum, nonreheat type, it supplies steam to a turbine generator with a nameplate rating of 132,500 kw. Two Foster Wheeler ball mill pulverizers furnish bituminous coal to twelve 30-inch FW intervane burners.

View looking south showing Pennsylvania Power & Light Company's new Martins Creek Steam Electric Station.

Backed by more than 50 years' experience in power plant equipment pioneering, steam generators by Foster Wheeler assure efficient, dependable performance at low overall cost. Whatever your requirements, it will pay you to consult us. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

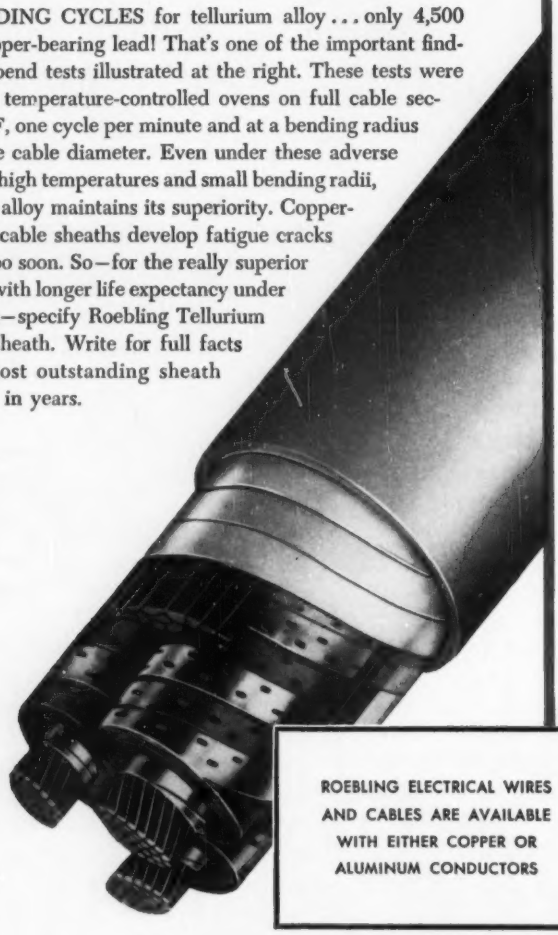
ROEBLING PAPER POWER CABLE WITH TELLURIUM LEAD ALLOY SHEATH

TELLURIUM LEAD ALLOY HAS

4½ TIMES

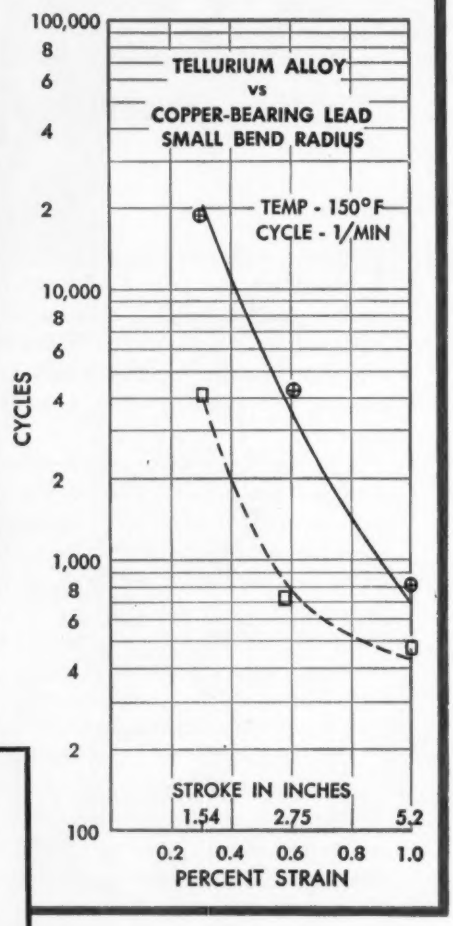
THE FATIGUE RESISTANCE OF COPPER-BEARING LEAD AT A BENDING STRAIN OF .3%

20,000 BENDING CYCLES for tellurium alloy . . . only 4,500 cycles for copper-bearing lead! That's one of the important findings from U-bend tests illustrated at the right. These tests were conducted in temperature-controlled ovens on full cable sections at 150°F, one cycle per minute and at a bending radius of 7 times the cable diameter. Even under these adverse conditions of high temperatures and small bending radii, the tellurium alloy maintains its superiority. Copper-bearing lead cable sheaths develop fatigue cracks *and fail* far too soon. So—for the really superior cable sheath with longer life expectancy under all conditions—specify Roebling Tellurium Lead Alloy Sheath. Write for full facts about the most outstanding sheath development in years.



U-BEND FATIGUE TEST

3/C - 350,000 CM - 2.7" DIA
BEND RADIUS - 19" - 7 x DIA
⊕ TELLURIUM ALLOY - 320° F QUENCH
□ COPPER BEARING LEAD



ROEBLING ELECTRICAL WIRES AND CABLES ARE AVAILABLE WITH EITHER COPPER OR ALUMINUM CONDUCTORS

ROEBLING

Subsidiary of The Colorado Fuel and Iron Corporation

JOHN A. ROEBLING'S SONS CORPORATION, TRENTON 2, N. J. BRANCHES: ATLANTA, 934 AVON AVE. • BOSTON, 11-15 STILLING ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 2340 GLENDALE-MILFORD RD., EVENDALE • CLEVELAND, 13335 LAKEWOOD HEIGHTS BLVD. • DENVER, 4501 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • PITTSBURGH, 1723 HENRY W. OLIVER BLDG. • SAN FRANCISCO, 1740 17TH ST. SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, 19 RECTOR ST., NEW YORK 6, N. Y.

Goes places a standard station wagon can't . . . carries up to 50% more payload!

Take a good look at the new Dodge *Town Wagon*—the ideal low-cost vehicle for your business! It's a double-duty carrier of passengers, cargo, or *both*. And with Forward Look styling it's as handsome as it is versatile!

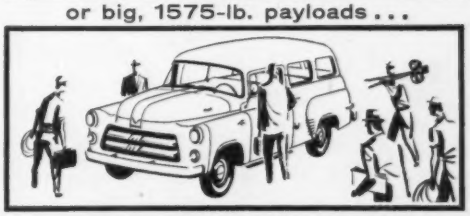
The *Town Wagon* is built on a rugged ½-ton Dodge *truck* chassis, giving you extra ground clearance for off-the-road driving. It's powered by either the famous Dodge L-head Six or the new Power-Dome V-8.

With seats in place, one model carries six passengers, the other eight. In the six-passenger model you've got about 90 cubic feet of load space in the rear compartment. The same amount of space is available in the eight-passenger model with the rear seat removed. You can also take all extra-passenger seats *out* of either model, leaving clear, unobstructed room for a big, truck-size payload of 1575 pounds.

You can see . . . and *drive* . . . the *Town Wagon* at your Dodge dealer's now.

Carry 6-8 passengers . . .

or big, 1575-lb. payloads . . .



or passengers plus cargo

DODGE TOWN WAGON

WITH THE *FORWARD* LOOK

MAIL TODAY!

Advertising Department C—Dodge Division
Chrysler Corporation
P.O. Box 1259—Detroit 31, Mich.

Please send me more information and complete specifications for the new Dodge *Town Wagon*.

Name_____

Street address_____

City_____ Zone____ State_____

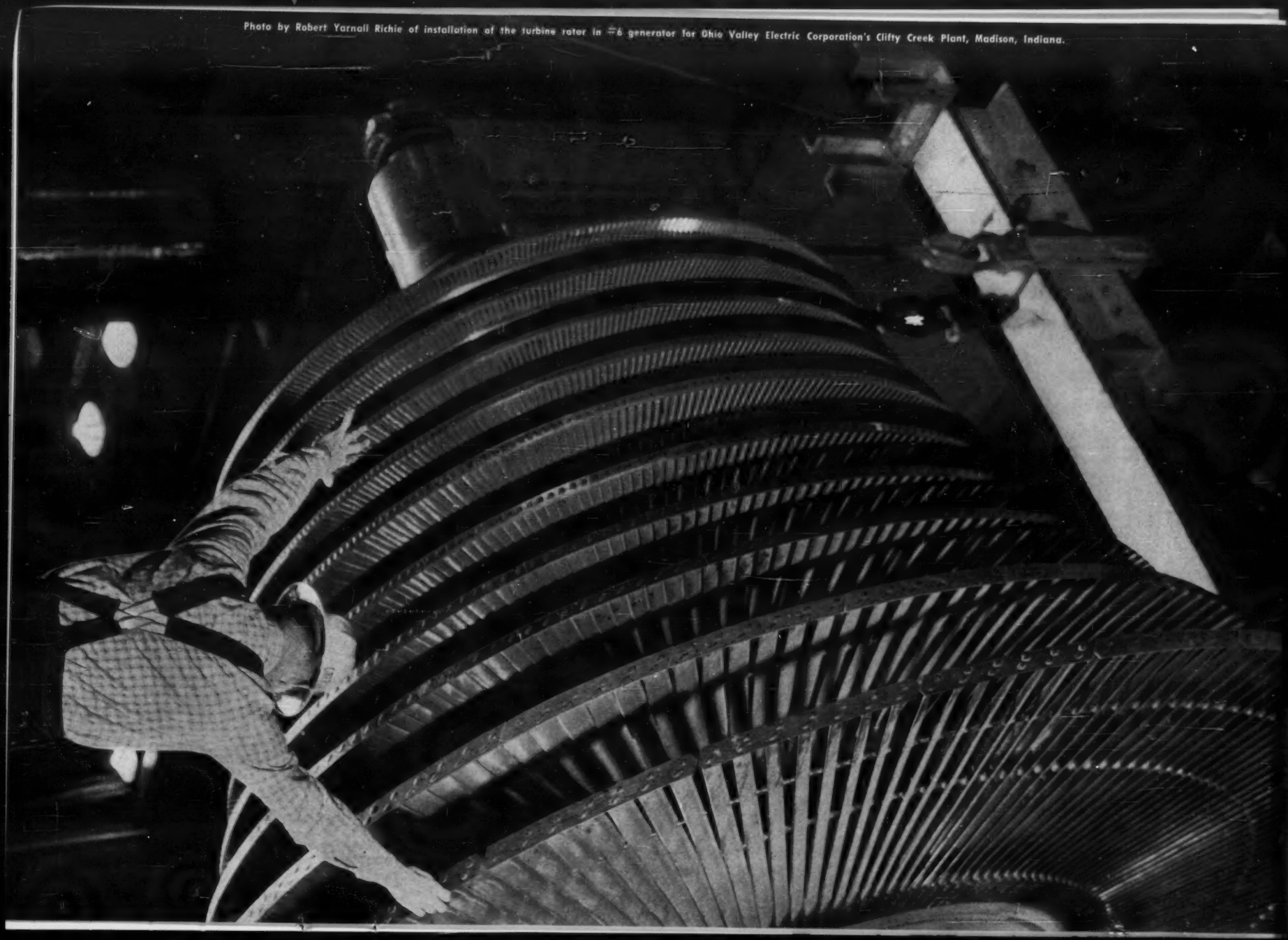


Photo by Robert Yarnall Richie of installation of the turbine rotor in #6 generator for Ohio Valley Electric Corporation's Clifty Creek Plant, Madison, Indiana.

What one magazine in the electrical world matches the quality of your own product?

Big? — sure this rotor's big, but its significance lies in *performance*, its part in generating (with 10 sister units) 2,365,000 kw, largest block of capacity installed on one system in one year. Power generated will be piped down off the high line at Portsmouth, O., for AEC use. That's the real pay-off, and it's much the same with us . . .

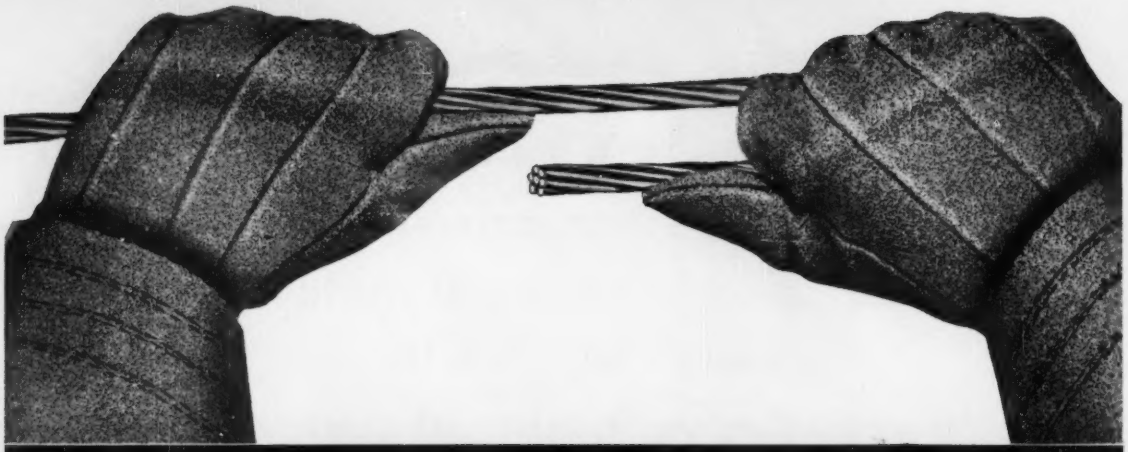
World's big*, sure, but its significance lies in the *readership* generated by 2,600 pages† of top-flight news-technical-business editorial — readership which is then piped from this "readership high line" into your advertising, for your use. Sixty-one percent of World advertisers use it *exclusively*, to transmit the power of their advertising to the industry. Doesn't this fact imply efficient sales generation?

*25,000 plus, ABC †1955 editorial page count

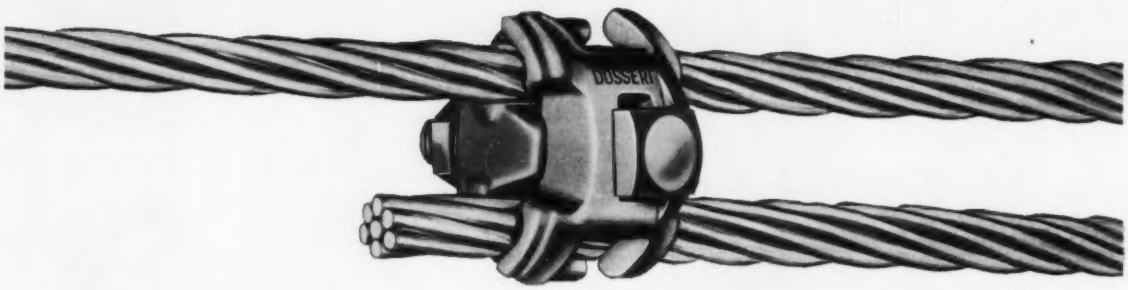
The Electrical Industry's Weekly Magazine

Electrical World

A McGraw-Hill Publication, 330 W. 42nd St., New York 36, N. Y.



The right connections are important!



AC101

DOSSERT ALUMINUM UNIVERSAL CLAMPS

★ Square head bolt permits tightening with either one or two wrenches, with the option of only one wrench since the head of the bolt is captive. With this feature, more than twice the clamping pressure can be applied, resulting in a better and more permanent connection.

★ Stainless steel Belleville spring washer used in preference to lock washer; this has the ability to "take up" without reducing clamping force when cold flow of soft aluminum conductors occurs. It also supplements the spring action of the casting for differential expansion which occurs during heat cycling.

★ Bolt is double-heat-treated for high tensile strength. Bolt and nut are hot-dip galvanized.

★ Clamps have an extremely wide range of conductor sizes on either groove.

★ Made of non-copper bearing, 356T6 Aluminum alloy for greater strength and higher corrosion resistance.

★ Rapid installation, no special tools required. Can be used for service taps, dead ends and splices. Broad contact surfaces provide excellent electrical and mechanical connections. Practically indestructible, completely reusable. Very low cost.

These clamps are available with various types of corrosion inhibiting coatings and with aluminum or other special hardware.

WRITE for detailed information, prices and samples on our AC series.

50 YEARS OF TECHNICAL KNOW-HOW

DOSSERT MFG. CORP.
249 Huron Street, Brooklyn 22, N. Y.
Representatives in all principal cities.
IN CANADA: W. S. Gerrie & Assoc., Ltd., Toronto

"Babe, this here's a ree-tort," explained Paul Bunyan to his faithful Blue Ox. "Fer pressure treatin' wood. Them Baxter folks never dunk it, er spray it, er paint it. They got a real fancy process: They stick the wood inside this ree-tort, lock her up fer 20 hours, and when she comes out she's BAXCO pressure treated—chock full o' presarvatives." The great logger scratched his head with a pine tree. "I dunno how they do it, Babe, but them Baxter boys shore treat wood good—they make it last forever." *

BAXCO PRESSURE TREATED FOREST PRODUCTS

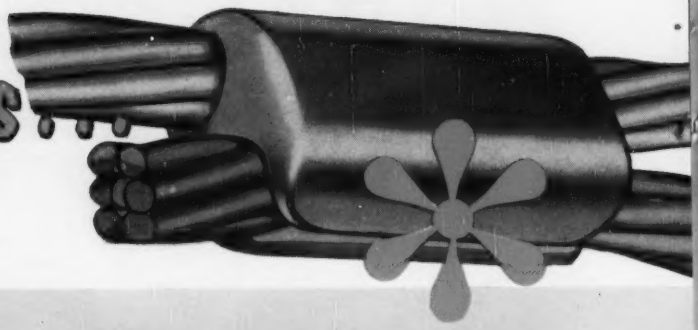
* Not quite *forever*, Paul—but wood, properly pressure treated, does last up to ten times longer. For maximum long-life protection against insects and rot, authorities agree that wood preservatives should be applied by pressure treating—and BAXCO Forest Products are *always* pressure treated. As West Coast pioneers in the wood preserving industry, our experienced engineering staff can assist in supplying you with the right preservative, the proper treatment, for any job. For a prompt quotation—inquire today.

Preservative treatments available: Creosote, Creosote-Petroleum solution, Creosote-Penta solution, Penta, Chemonite, Chromated-Zinc-Chloride, and Protexol fire retardants.

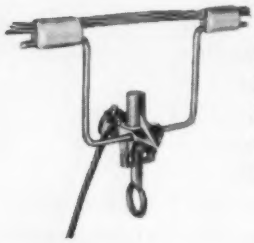
© J. H. Baxter & Co. 1956

J. H. BAXTER & CO. *120 Montgomery Street, San Francisco 4, California*

for all types...



KEARNEY SQUEEZONS...



*** for STIRRUPS**

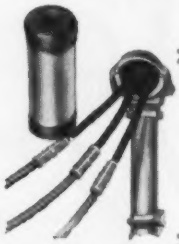
Because of the exclusive KEARNEY built-in spacer, Squeezons are ideal for making copper bail stirrups for aluminum or ACSR lines.

*** ... L-TAPS**

For making bimetallic connections under extremely adverse operating conditions, Squeezon L-Taps provide adequate separation of conductors.

*** ... T-TAPS**

For making line taps to conductors larger than accommodated by Squeezons, T-Taps have ample mechanical strength to support tap wire and grip conductors.



*** for SERVICE ENTRANCES**

KEARNEY Serv-Ens... with built-in barrier... for all service entrance connections.

*** .... TERMINAL ADAPTERS**

Aluminum conductors may be connected to bronze or copper terminals of transformers, cutouts, capacitors, etc.... with Serv-Ens Adapters.

*** ... DEAD ENDS**

For dead-ending copper, aluminum or ACSR at both pole and house end, aluminum or copper Squeezons used in series of two or more are capable of developing the full strength of the conductor.

-317

for BETTER CONSTRUCTION
SAFER MAINTENANCE
Specify

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO. GUELPH, ONT.

The Mark of Quality

KEARNEY PRODUCTS

# of COMPRESSION connections

. . . most versatile connectors you can use

There's a KEARNEY Squeezon for every open-wire distribution system connection . . . for all combinations of copper and aluminum conductors.

Incorporated in the Squeezon design are the practical, field proved answers to achieving uniform compression, eliminating contact surface corrosion, maintaining tight contacts. Use Squeezons for every compression connection . . . *connect for keeps* in less time . . . at less cost!

Corrosion Tested

Here in KEARNEY's Salt Fog Chamber, Squeezons undergo rigorous testing in a salt air environment to check electrolytic action. Current flow from the heat-cycle switchboard intermittently induces temperature changes in the connections. This recognized method of testing—also used by the Army and Navy—assures you of more efficient connections with longer service life everywhere, especially in coastal areas.

JAMES R. KEARNEY CORPORATION

4224-42 Clayton Avenue · St. Louis 10, Missouri *Canadian Plant:* Guelph, Ontario

How to

get to the bottom of grounding problems

If high-resistance grounds are causing you problems, here's a simple, low-cost way to solve them. Drive Copperweld* Sectional Ground Rods deep into the earth's sub-surface to reach permanent moisture, where resistance is always low.

By using this proved, practical method, you'll have dependable grounding protection every day in the year. And then you can be certain you'll always get the best performance from the protective equipment on your overhead systems.

Trade Mark

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION *Glassport, Pa.*
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

GO DEEP with Copperweld TRADE MARK **sectional ground rods**

PERMANENT MOISTURE

Look to SANGAMO for Capacitor Controls

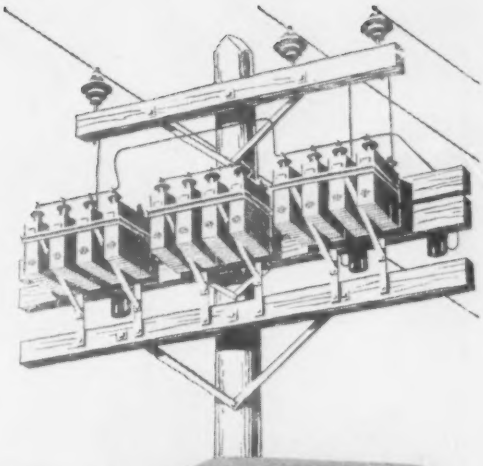
TO FIT YOUR NEEDS...

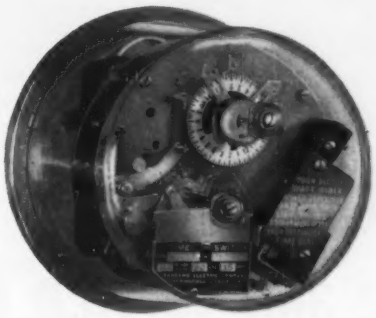
Whether you control capacitor switching as a function of Time, Amperes, Volts, Watts or Vars—Sangamo can furnish economical and reliable control equipment.

Sangamo Time Switches are synchronously operated and may be equipped with automatic carryover to keep them "on time" during current interruptions.

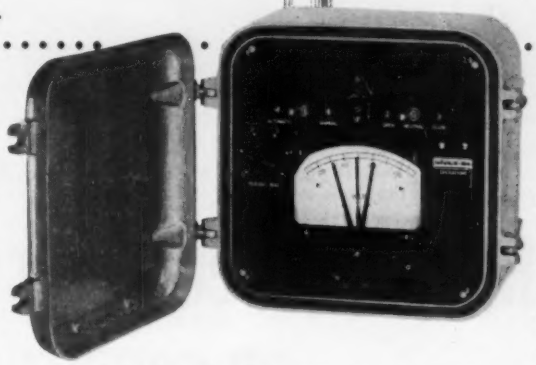
Sangamo Lincolntrols provide automatic capacitor switching in response to changes in circuit conditions.

Ask your Sangamo Representative, or write us today.

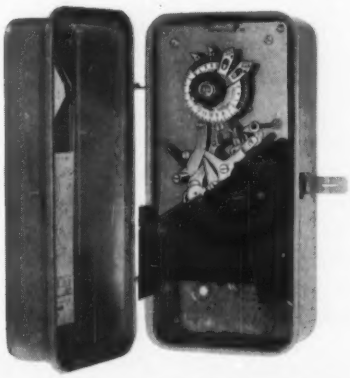




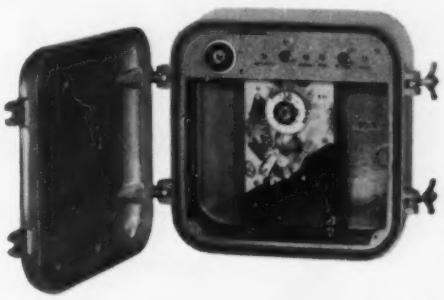
Type WS Synchronous-Carryover Time Switch for socket mounting.



Type VS Socket-connected Lincolntrols switch capacitors as a function of voltage. Type AS is sensitive to amperes, Type RS responds to kilovars. Bottom connected, as well as other mountings, are also available.



Type L Synchronous Time Switch in gasket-sealed case.



Type AW Synchronous-Carryover Time Switch for socket mounting, includes fuse and switches for manual and automatic operation.

SANGAMO ELECTRIC CO.

Line patrol. The Universal 'Jeep' carries patrol and service crews and equipment along the right of way to structures in off-road locations. It travels in conventional 2-wheel drive at highway speeds, but shifts easily into 4-wheel drive for extra traction to go through mud, soft earth, sand or heavy brush—or climb steep grades—where other vehicles can't go.

How 'Jeep' vehicles cut costs on construction and service jobs

Maintenance. The 4-wheel drive 'Jeep' Truck takes repair crews and equipment wherever they're needed, on or off the road. With the extra traction of its 4-wheel drive, it gets through to trouble spots when storms or other emergencies knock out service.

Trenching. The 'Jeep'-propelled trencher digs up to 800 feet of clean-cut 6-ft. deep trench per hour, to speed the installation of cable, conduit and service lines. Unit travels at highway speeds between jobs.

From line installation through maintenance and other service activities... the electrical industry is served on job after job 24 hours a day by 4-wheel drive 'Jeep' vehicles.

With the extra traction of their 4-wheel drive, 'Jeep' vehicles take crews and equipment off the road, right to the tower or substation, wherever service is required.

'Jeep' vehicles with power take-off operate a wide range of equipment, including generators ... compressors ... mowers ... post hole diggers... winches... and many more.

Learn how the electrical industry uses multi-purpose 'Jeep' vehicles for hundreds of different jobs, from installing meters to stringing high lines, and how these vehicles save owners money through long life and low maintenance costs. See your Willys dealer today, or write for information.

The 'Jeep'®

family of 4-wheel drive vehicles

WILLYS... makers of the world's most useful vehicles

WILLYS MOTORS, INC., TOLEDO 1, OHIO

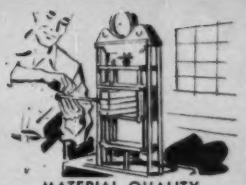
Tests made by Moloney are basic indicators of the performance, dependability, and service life you can expect of every HyperCore Transformer. More important, however, are the test methods Moloney uses and the significance of each test. That's why Moloney employs only test methods based on intelligent, progressive engineering, to provide truly significant and meaningful tests . . . tests that are the true measure of a HyperCore Transformer's performance.

Assembled here are fundamental tests, made automatically by Moloney, on

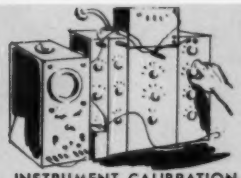
TESTING 1 2 3

material, test instruments, cores, coils, assembled units, and transformer tanks to insure superior quality and long service life for every HyperCore Transformer. In addition, Moloney's new automatic test system, described on the following pages, tests and evaluates completely assembled transformers *electronically*, insuring test accuracy and eliminating human error.

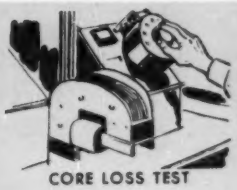
Moloney's new test system is your assurance that dependable HyperCore Transformers are better than ever . . . for your utility system.



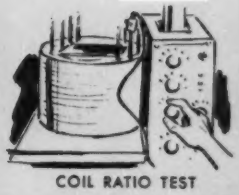
MATERIAL QUALITY CONTROL TESTS



INSTRUMENT CALIBRATION, TESTING

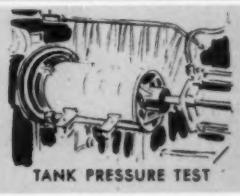


CORE LOSS TEST



COIL RATIO TEST

RATIO, CONTINUITY TEST



TANK PRESSURE TEST

Bulletin H 307-356

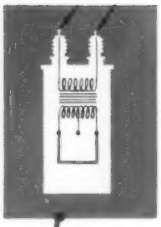
MOLONEY ELECTRIC COMPANY

FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA

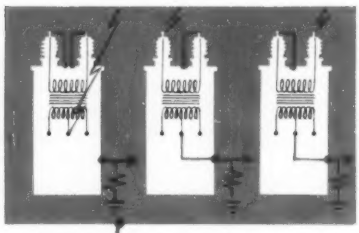
SALES OFFICES IN ALL PRINCIPAL CITIES

TESTING

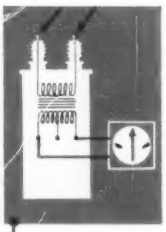
COPPER LOSS TEST is a quality control check, insuring good circuits and connections. Test is made by supplying transformer windings with the rated current to check the load watts.



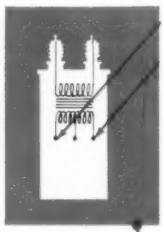
IMPULSE TEST proves *each* transformer capable of withstanding overvoltages resulting from lightning and switching surges by overstressing bushings, layer, turn and divisional insulation as well as insulation between high and low voltage windings, and between the windings and ground. Power for Moloney's automatic impulse tests on distribution transformers is supplied by a specially designed impulse generator capable of developing 120,000 volts. Moloney's fault detector evaluates impulse test results *electronically*, eliminating human error and insuring accuracy.

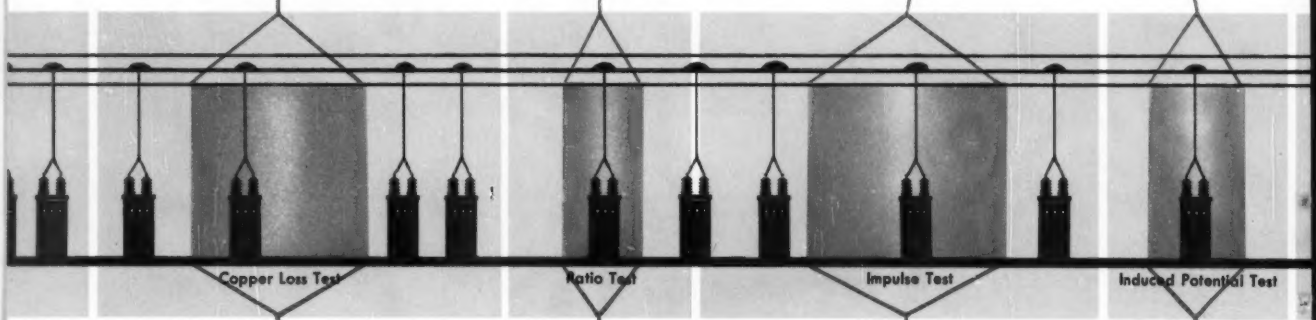


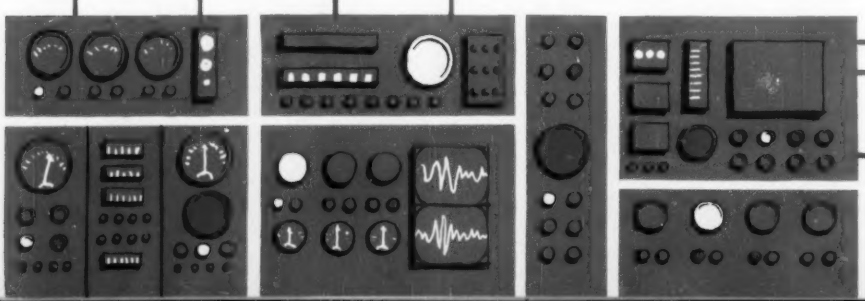
RATIO TEST, supplementing the complete ratio test given each core-and-coil unit before tanking, checks each transformer for correct voltage ratio and ratio adjuster position. Test is made by supplying a constant known voltage to high voltage windings. The resultant voltage induced in low voltage windings is automatically measured... electronically.



INDUCED POTENTIAL TEST proves turn, layer and divisional insulation quality of high and low voltage windings. Test is performed by inducing above normal voltage at increased frequency in transformer windings.







CONTROL ROOM—Central control room houses all test station controls, test metering and recording equipment, and electronic rejection circuits. Control room atmosphere is filtered and pressurized to eliminate dust and dirt, insuring accuracy of tests.

7 8 9

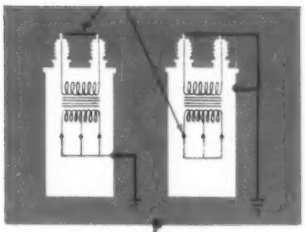
Designed and developed by Moloney's own engineers, Moloney's new, automatic test system is indicative of the creative and forward thinking inherent in every HyperCore Transformer. Moreover, Moloney's new test system provides vitally important tests . . . automatically . . . making dependable HyperCore Transformers better than ever . . . for your utility system.

Moloney's new test system insures test accuracy because each piece of test equipment is designed and used only for a specific test . . . and because human error is eliminated. Electronic equipment tests and evaluates *each* transformer, and rejects substandard transformers . . . automatically.

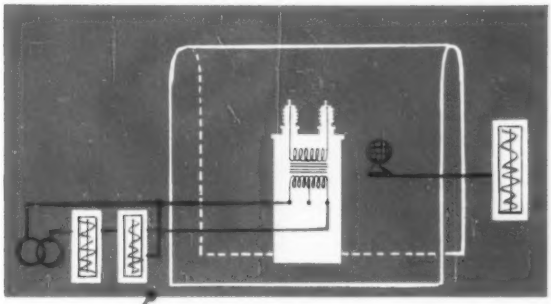
It's your assurance that every HyperCore Transformer you get meets NEMA standards *plus* Moloney's own high standards for quality and performance dependability. It's your assurance that HyperCore Transformers are better than ever . . . for your utility system.

CORE LOSS TEST equipment automatically measures and records the core loss and exciting current of each transformer. Core loss test is performed with normal excitation voltage supplied by a 60 cycle constant voltage sine wave alternator, designed specifically for the test to insure accuracy.

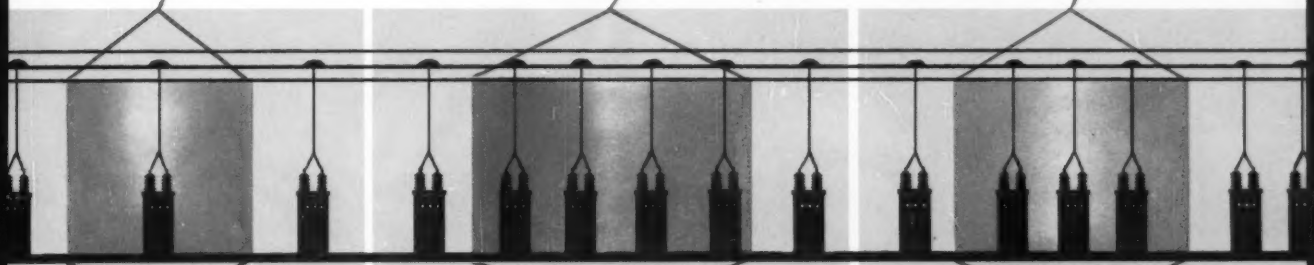
SOUND TEST equipment measures and records . . . automatically . . . the audible sound level of *every* transformer while under normal excitation voltage. Test is performed . . . automatically . . . when each transformer is precisely centered in an 18-foot, double-walled test chamber. Dependable, accurate tests are insured because Moloney's sound proof test chamber is engineered to have a lower ambient noise level than found in most radio broadcasting studios.



APPLIED POTENTIAL TEST is a low frequency, high voltage test of insulation quality between high and low voltage windings, and between windings and ground. Test is performed by applying standard voltage (for the transformer's insulation class) to the high and low voltage windings successively. Winding not being tested is grounded.



CSP BREAKER TEST equipment checks signal light and breaker operation under overload conditions.



TEST SYSTEM—After completion of all assembly operations, a moving belt conveyor transports transformers through test line. Connecting cables for tests, attached before transformers enter test area, are carried by overhead dollies. Power for each test is supplied . . . automatically . . . by overhead bus at each test station. Tap changes and other operations required by transformers of different voltage ratios, insulation classes, etc., are done remotely from master control room. Test system personnel are restricted from test line; electric interlocks stop test system if anyone enters restricted area.

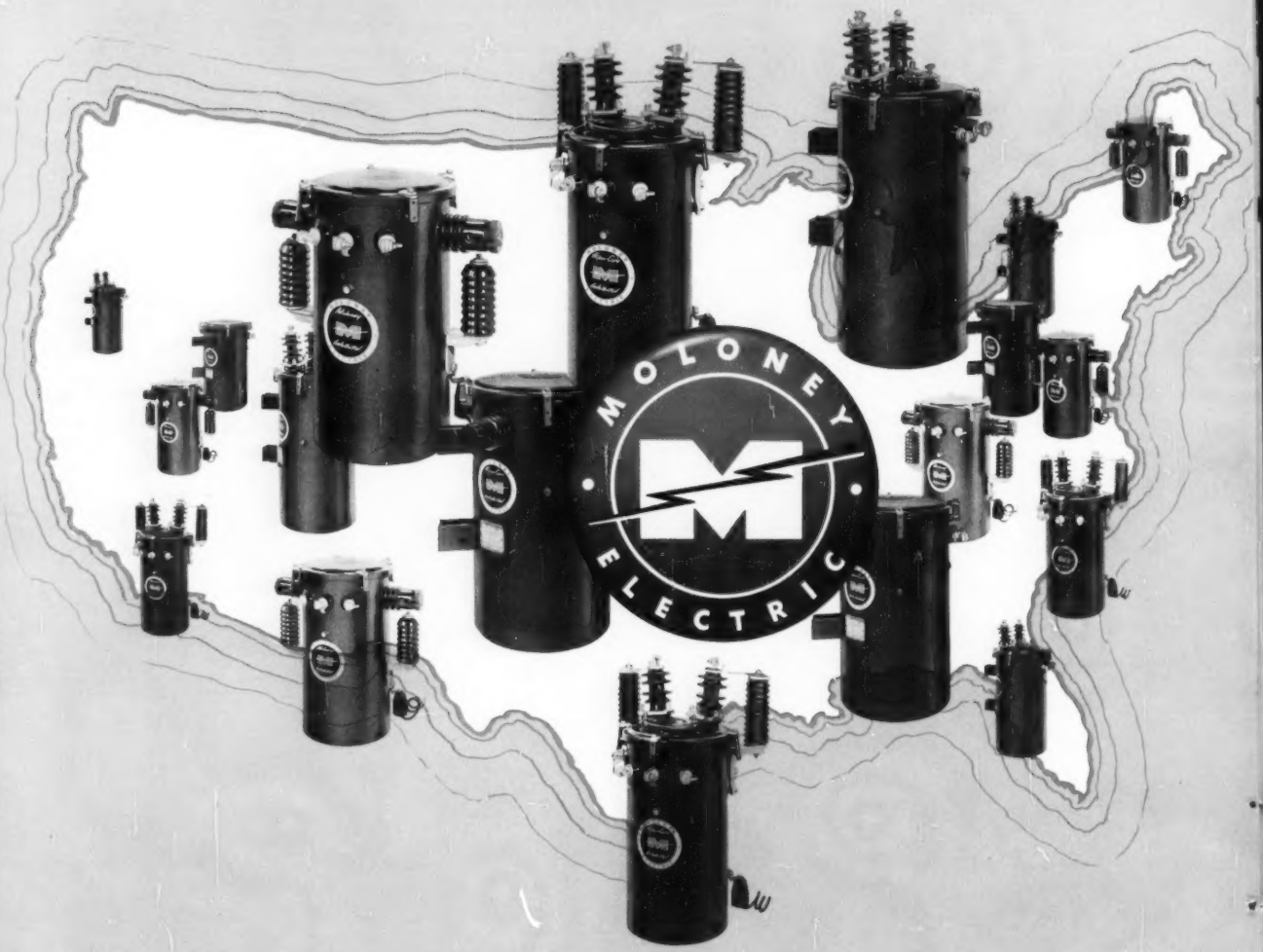
MOLONEY ELECTRIC

Specify Moloney . . . Get HyperCore Transformers . . . NOW From Warehouses Near You

Moloney's new automatic test system plus increased production capacity and production flexibility means dependable HyperCore Transformers are available . . . *right now* . . . in the quantities, ratings and types you need.

Strategically located and well-stocked warehouses—*there's one near you*—means better-than-ever HyperCore Transformers are available *where* you need them . . . *when* you need them.

Specify dependable Moloney HyperCore Transformers . . . they're better than ever . . . for your utility system.



MOLONEY ELECTRIC COMPANY

Power Transformers • Distribution Transformers • Load Tap Changing Transformers • Regulating Transformers • Step Voltage Regulators • Primary Unit Substations • Secondary Unit Substation Transformers Network Transformers • Series Street Lighting Transformers • Subway Transformers • Industrial Dry Type Transformers • Capacitors • Magnetic Components For Electronics

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA

Litho in U.S.A.

EDITORIALS

Extra High Voltage Moves Forward

Extra high voltage transmission is one of today's best investments. Its economic feasibility has been demonstrated and its technical soundness proven. The work of the pioneers is finished. The first lines have been built and are operating successfully. They have done their job of demonstrating the feasibility of the higher transmission voltages.

Today the industry faces the next step, the task of refining the technology of extra high voltage and extending its area of application.

In their pioneering, the risk-takers inevitably uncovered areas of technology requiring further exploration. These must still be explored before engineers and operators will feel as thoroughly at home with 345 kv as they now feel with lower voltages.

These required refinements in technology are of two broad types. First there are the practical ones of extrapolating known areas of lower voltage design into the higher voltage classes: Matters of structure design and the perfection of bundled conductor technique are two problems in this area. Second is the more involved and far-reaching group of problems associated with corona and radio and television interference as well as lightning performance.

The industry today is accepting and applying extra high voltage transmission at an accelerated rate. In doing so utilities and manufacturers are taking a highly practical approach to the problems they pose. Rather than rely solely on theoretical design considerations, they are building full-scale research stations and line sections to test, measure, weigh, and observe various effects under operating conditions.

On the pages of a special report in this issue are examples of some of the planning studies, some of the extrapolation of design, and some of the experimental facilities being set up to perfect and refine the technology of EHV. Here too are reports of some of the latest applications of EHV to power systems in the U.S. and the philosophy behind them.

This continuing investment in research and development—this refinement of design and application techniques—is the best guarantee that extra high voltage will provide the solution for many of tomorrow's transmission problems.

Utility Recruiting Must Go "Big Time"

One of the contributing causes—perhaps the main one—for failure of electric utilities to get young engineers is their recruiting methods. In today's "sellers' market" recruiting has gone "Big Time." Here is the way the non-electric companies are filling their staffs:

They hire fulltime recruiters. These "professionals" know not only how to "sell" their own companies to the seniors, but they also know the kind of man to "buy" for them. They also know a great deal about every college at which they recruit—the strength and weaknesses of each of its departments and curricula.

They not only meet the college placement directors on the campuses, but they follow them to the meetings of their regional associations.

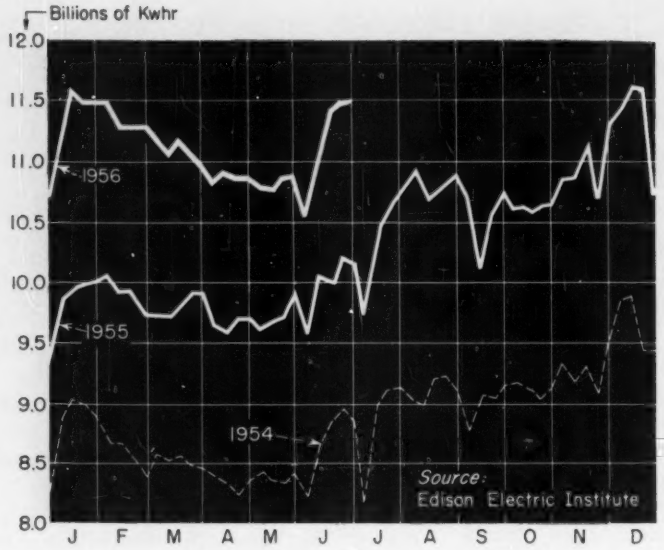
Now let us look at the way these placement directors affect the employment picture.

With as many as 400 or more companies recruiting at a single college, the placement director's job is far different from that in 1939. He still counsels the seniors, but his main task is to get the recruiters and seniors together. He does not attempt directly to steer students to any particular company but indirectly his scheduling of conferences does. This one factor alone has undoubtedly robbed the electric utilities of many talented young engineers.

The conference season opens late in October. First chance at the graduates commonly goes to those companies which have recruited longest at the college and have been big employers. These schedules are set up a year in advance. "Old timers" usually have the right to reserve the corresponding dates each year. As few electric utilities did any widespread recruiting until a few years ago, they usually have little "seniority" except at a few colleges in their service areas.

Furthermore many directors limit seniors to around a dozen interviews. This means the best prospects are grabbed up before the companies at the end of the line get to see them.

With the demand for engineers likely to remain high for years to come, electric utilities will have to go "Big Time" to get the ones they want. One way is to hire a fulltime recruiter. As this would be uneconomical for the average company, a group of companies in one region (perhaps all the members of a regional association) might hire such a recruiter on a pool basis. A further advantage in this case would be that he would have "more jobs in his pocket" than would a single company representative.



OUTPUT

Week ended June 30
11,498,000,000 Kwhr
Up 13.4%

Atomic Energy Commission requirements—1,125,000,000 kwhr (Electrical World estimate). Excluding AEC, output increase was 11.7%

Per Cent Change From Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
June 30	+13.4	+11.2	+9.5	+16.8	+13.6	+12.5	+17.1	+11.4	+10.9	+12.9
June 23	+12.2	+9.8	+5.8	+17.5	+19.6	+9.3	+17.6	+13.2	+11.9	+7.4
June 16	+14.4	+12.8	+10.5	+18.3	+19.8	+11.2	+22.1	+17.1	+13.6	+7.3

Seasonally Adjusted Index 219.7 Week Ago 218.2 Year Ago 193.9

Issue's Highlights . . . Buckley bill, containing preferential clause, is passed by House Public Works Committee and awaits green light from House Rules Committee; officials of utilities affected by bill issue comments . . . Greatly revived interest in high-voltage dc transmission crops out at CIGRE . . . Kitimat loses water head; rock fall in tunnel is suspected.

As EW goes to press, **two federal mediators are in session with management and labor representatives of Ohio Edison** in effort to work out new labor contract. Present contract expired June 30, but there is no work stoppage. Plants are operating on shift-to-shift basis with local union leaders holding authority from hourly workers to call a strike anytime.

Commonwealth Edison offers $4 million for purchase of village-owned 15,500-kw plant and distribution system of Winnetka, Ill. Edison proposes to make 50 annual payments of $155,462. This total of $7,773,100 represents amortization of base purchase price in 50 years at 3% interest.

Plans to build 700-ft-high Mica Creek Dam and power project on Columbia River about 225 miles north of the international boundary are disclosed by British Columbia Power Corp. The $250-million project will develop about 1.1-million kw that will be transmitted to Vancouver at **record 500 kv over 400 miles of bundled conductor.** Two to three years of surveys will begin at once; another five to seven years will be needed for construction.

In order to make a $9-million refund to more than 275,000 customers, Arkansas P&L asks state PSC to approve arrangements made with Hanover Bank of N. Y. for loan of $8 million. PSC recently directed the company to refund "excess amount" collected under rates in effect since July 1, 1954 . . . Central Maine Power asks state PUC for rate increase of about 5.3%.

NEWS OF THE INDUSTRY BRIEFLY TOLD

Washington Wire . . . $400-million government program for large atomic power plants (Gore bill) is cleared for debate in House and Senate by 14-0 favorable vote of Joint Atomic Energy Committee. Original proposal lost its public power flavor when modified to specify that AEC will build the reactors at AEC sites for AEC consumption. No plant can exceed 50,000 kw . . .

Several western utilities were visited last week by investigators for House Public Works (Chudoff) subcommittee. Their questioning indicates an interest in the consulting services being used by electric companies . . . **Public power groups lose a round** in their efforts to halt Idaho Power's construction of three dams on Snake River. U. S. Court of Appeals denies one petition to stop work on Brownlee Dam and another petition to hear oral arguments on the request for staying of the FPC license to Idaho Power . . .

President signs $863-million Public Works Bill with reluctance because of 52 extra projects tacked on. Bill carries $5.4 million for TVA, $1.4 million for Southeastern Power Administration, $1 million for Southwestern Power Administration, and $26 million for Bonneville Power Administration . . . **AEC appoints Dr C. Rogers McCullough** of St. Louis, Mo., deputy director for hazards evaluation in Division of Civilian Application.

An explosion resulting from the ignition of thorium metal scrap injures nine employees at Sylvania Electric Products Co's metallurgy laboratory at Bayside, N. Y. The blast—chemical, not nuclear, in nature—occurred when the scrap was being converted to the more inert oxide form. Radiation checks after accident showed only normal background radiation in the laboratory and only radiation expected from thorium in the area where the accident happened. Thorium, a fertile material which can be converted into fissionable uranium in a reactor, is only mildly radioactive.

Kidder, Peabody & Co and Merrill Lynch, Pierce, Fenner & Beane **group wins $20-million Florida Power Corp first mortgage 3⅞% bonds** due 1986 at 100.269%; reoffers at 100.977% to yield 3.82%. Three other groups had identical bids of 101.909% for a 4% coupon.

ABOUT PEOPLE IN THE INDUSTRY

"Our customers will at least double their requirements of energy in the next 10 years," Don Kennedy, president of Oklahoma G&E and Edison Electric Institute, tells North Central Electric Association. In his first address as EEI's president, Kennedy says, "This means we must provide as much more in new facilities by the end of 1966 as we had at the end of the 77-year period since the advent of the electric light."

"We are living in a high-velocity world today by all standards of comparison," declares M. S. Coover in accepting presidency of AIEE. Coover, professor of electrical engineering at Iowa State College, tells AIEE convention, "All who have had specialized training in the various areas can have a real influence if we will but make the best use of our heritage by assuming both our privileges and our duties as citizens."

More News About People page 162

Niagara's Fate Hangs in Balance As

- House Public Works Committee votes approval of Buckley bill, identical to Lehman bill already passed by Senate

- A quick House authorization—if it comes—will toss the public-private issue into Eisenhower's lap

The House of Representatives may soon call up the Buckley bill for a quick vote while winds blow strong from public power headquarters. As Electrical World went to press, here is what had happened in a flurry of behind-the-scenes maneuvers that might authorize hydro development of Niagara Falls by New York State:

The House Public Works Committee approved New York State construction of the $440-million hydro-electric plant at Niagara Falls, N. Y., by an 18-16 vote. The measure now faces clearance before the House Rules Committee before coming up for floor debate.

The measure, sponsored by Sen Herbert H. Lehman (D-N. Y.) and Rep Charles A. Buckley (D-N. Y.), is identical with the one that passed the Senate, 48-39, last month. Although no vote was announced, two Republicans joined 16 Democrats in supporting the public power bill, while three Democrats and 13 Republicans opposed it.

The bill includes the controversial "preference clause," which gives first call on buying Niagara power to municipal electric systems, rural electrical cooperatives, and federal defense agencies. It also authorizes the state to build transmission lines wherever necessary to get Niagara power to customers.

REP BUCKLEY: sponsors Niagara bill

House Approval "Assured"

Public power forces claim that House approval of some form of state construction now seems assured. The fate of the preference clause on the House floor is uncertain, but the Senate will insist on it in conference.

The House committee first defeated a proposal by Reps George A. Dondero (R-Mich.) and William E. Miller (R-N. Y.), authorizing private utility companies to construct the plant, by a 20-14 vote.

A forecast stalemate in Congress on the Niagara fight was broken June 7 by a spectacular rockslide that wrecked the Niagara Mohawk Power Corp's Schoellkopf plant at Niagara Falls, N. Y. (EW, June 18, p 8).

Manufacturing Industry Grumbles

The high cost of power brought in to replace the Schoellkopf loss set area industry grumbling, and the protests—coupled with threats to move out of western New York unless low-cost power were promised in the near future—impelled Niagara Mohawk to compromise their long-standing opposition to state construction of the big hydro-electric plant.

On June 22 the Niagara Falls Chamber of Commerce, under pressure from complaining local industries, telephoned Miller and said that low-cost power had to be made available in the near future to save an industrial walkout. Miller passed the word to Niagara Mohawk.

Compromise Sought

On June 25 Niagara Mohawk and the New York State Power Authority asked the House committee to delay a vote so they could work out a compromise. Two days of talks in New York City followed, and on June 28 Niagara Mohawk offered Congress a three-point compromise package.

One point was elimination of the preference clause. It lost out, but there is a strong chance that the other two will be settled by negotiation. They are:

- Assurance that Niagara Mohawk would get from the state power produced from the 20,000 cfs of water that had been used at Schoellkopf.
- A promise by the New York State Power Authority—which under the Buckley bill would build the plant—to try to obtain state legislative approval for payments in lieu of taxes to the city of Niagara Falls to replace the tax loss incurred by the Schoellkopf disaster.

"A Case of Railroading"

Rep Gordon H. Scherer (R-Ohio) complained angrily that the Public Works Committee's failure to allow a vote to strike the preference clause from the Buckley bill constituted the "worst case of railroading I have seen since I have been in Congress."

The heads of four other private companies that had been striving for a Niagara license—Rochester Gas & Electric Corp, Consolidated Edison Co of New York, Inc, Central Hudson Gas & Electric Corp and New York State Gas & Electric Corp—had said they would accept the compromise only as a "last resort."

Investigation Hinted

Lawmakers supporting the Miller-Dondero bill accused Niagara Mohawk of "pulling the rug out from under" those who had fought for private power. They hinted that the utility had made a "deal" with New York State power officials. Rep J. Harry McGregor (R-Ohio) hinted that a Congressional investigation might be in order.

This pressure led to a caucus by Republican committee members before the vote Friday, with only two absentees. Rep Frank J. Becker (R-N.Y.) said the caucus agreed "no middle-of-the-road proposal" would be acceptable.

Niagara Mohawk's Position

The Schoellkopf disaster resulted in a loss to Niagara Mohawk of 334,800 kw. The same water that had been used there, informed sources say, would yield 500,000 kw at the new Lewiston plant.

Buckley Bill Gets OK

The utility's Lauman Martin said, "Some concessions had to be made promptly to secure the necessary legislation." The largest single installation in the company system had been destroyed,—a "heavy blow" to the company—and the utility had to work out rate adjustments so service might continue in western New York.

Reconstruction of the Schoellkopf plant would be neither economical nor efficient, he pointed out, so the company had to take a "calm, deliberate, and careful look" at the legislative picture. Niagara Mohawk's plan was to surrender its present Federal Power Commission license, which runs out in 1971, and take a 50-year lease on the same water channeled into the state hydro plant. With Niagara Mohawk's needs due to "at least double" by 1965, Martin said, "we've got to come a long way to a reasonable solution."

Although Niagara Mohawk did not endorse the state construction bill outright, it did lead to changes in the political picture.

At least one member of the upstate New York Republican delegation, who had stood firm for private power, has now indicated he may vote for the Buckley bill.

Throughout the last-minute activity, Niagara Mohawk made it clear that it was acting on its own and could not speak for the other companies that had joined it in moving for Congressional approval of their Niagara program.

Commented Sen Lehman, who has been pushing for public power Niagara legislation for six years, "The end is almost in sight now—or, rather, the beginning of a great new harnessing of these tremendous waters for the public use and benefit."

REP SCHERER: "worst railroading . . ."

Here's What the 5 Utilities Are Saying . . .

Shortly after the Buckley bill had passed the House Public Works Committee, it was indicated to Electrical World that the five utilities involved never had been more closely allied.

All five of the New York State companies issued statements on the Niagara development. Here are excerpts that explain and round out the picture:

E. J. Machold, Niagara Mohawk

Pres Earle J. Machold, Niagara Mohawk Power Corp, said, "The action of the House Public Works Committee on June 27 in reporting out the Buckley-Lehman bill for state construction and operation of the Niagara River project, with the imposition of the federal preference policy in the disposition of project power, was a bitter disappointment to our five-company group of New York utilities. It was no less a disappointment to the people in the project area who have so staunchly supported us in our vigorous efforts over the past six years in opposition to that bill and in support of Congressional authorities for a development by private enterprise.

"Under the tremendous economic pressure resulting from the loss of the Schoellkopf plant at Niagara Falls, and in the light of the expressed willingness of the Power Authority of the State of New York to cooperate in the deletion of the preference clause, we gave serious consideration to a middle course which would result in state construction of the project. However, while the Public Works Committee encouraged compromise talks by unanimously postponing its deliberation, it developed that the public-private power issue was so sharply drawn in the committee that neither faction would countenance a middle course.

"In its executive sessions on June 27, the committee reported out the extreme public power bill by a very close vote, permitting no opposition for amendments.

"In view of the foregoing developments, the five companies are more determined than ever in the vigorous opposition to the Buckley-Lehman bill and in support of construction by private enterprise.

"We are most confident that not withstanding the impact of the Schoellkopf plant disaster, the people in the project area who are directly concerned will continue in their enthusiastic support of our position."

Alexander M. Beebee, RG&E

The Buckley-Lehman bill, said Alexander M. Beebee, board chairman of Rochester Gas & Electric Corp, could lead to another TVA. The five companies were willing to compromise to "ward off the evils of this bill."

"The accident at Niagara Falls created legal problems as well as political and economic issues that greatly complicated our position," he said. As a result, this subject was caught in the House in a maelstrom of pre-election politics. If the Buckley-Lehman bill becomes law (it already has passed the Senate) we will be faced for years to come with developments that could be disastrous for private enterprise.

"As you are aware," he continued, "efforts are being made to correct the evils and injustices which TVA has created. The time to make those corrections is before they start, rather than after they have become woven into the economic fabric of the area. We did not, however, wish to be a party to the continuance of a stalemate."

He said a telegram was sent the Public Works Committee stating that "we whole-heartedly support private

(*Continued on next page*)

Here's What the Five Utilities Are Saying . . .

BEEBEE: "Another TVA . . ."

enterprise development and oppose the Lehman bill," but prefer as a last resort a compromise rather than no development at all. But the bill won committee approval without compromise, he said.

"We cannot believe it is the wish of the people that this bill become law. It is primarily favored by those in political life who want to see the government get greater control over the economy of the country. We hope the House and the people of this country will rise up and vote down such an unjust and unfair bill that can only tend to create more and more tax-avoiding privileges and give preference to favored groups. The time has come in this country when those in political life should support tax-paying enterprises and insist on equality in taxation and equality in opportunities."

Joseph M. Bell, Jr, NYSE&G

"So far as New York State Electric & Gas Corp is concerned," said Joseph M. Bell, Jr, president, "we believe whole-heartedly, as we have continuously, that this development should be made by private enterprise. We have fought for this principle for six years. In 1953 the House of Representatives, by a vote of 262 to 120, passed a bill to permit development of the project by private enterprise, only to have its counterpart bottled up in the Senate Public Works Committee. The bill died upon the adjournment of the 83rd Congress.

"Since then no Niagara bill has reached the floor of either the House or the Senate until the passage of the Lehman bill by the Senate last month, and the reporting June 29 of its identical companion bill, the Buckley bill, by the House Public Works Committee. Of course, we are unalterably opposed to those bills which will discriminate against the 95% of the electric consumers of the State of New York now served by investor-owned companies."

The Niagara rock slide, he continued, called for "elimination of further delay" in redeveloping the project. Therefore the five utilities supported the compromise proposal submitted to the House committee by Niagara Mohawk representatives.

"It was our considered judgment that the compromise proposal, while a last resort, was preferable to a continued stalemate under which there would be no development at all.

"Our company and, I am sure, the other participating companies now reaffirm our position in favor of passage of private enterprise legislation, and we shall continue to oppose the Lehman-Buckley bill with all our vigor."

Ernest R. Acker, CHG&E

Commented Central Hudson Gas & Electric Corp's Pres Ernest R. Acker:

"We were extremely disappointed in the action of the Public Works Committee. . . . (We) believe that an important principle is involved because, unlike other government power projects, at Niagara the production of power would be the sole purpose of the undertaking and such proper governmental functions as navigation, irrigation, and flood control would not be involved.

"The Buckley and Lehman bills not only would authorize a government agency to develop a tax-free power project but also contain provisions for the sale of the power on a preferential basis. These provisions are grossly unfair (because of their discriminatory nature)."

In view of the six-year stalemate, "many persons sincerely concerned with the prospects of the continued loss of use of the waters at Niagara Falls have urged that some steps be taken to break the deadlock between the proponents of private and public power."

Following the Niagara catastrophe, he continued, "the five companies concluded it was in the public interest to bring about an early solution to the problem. As a constructive effort in this direction, Niagara Mohawk tried to arrange a compromise with the New York State Power Authority based on the principle the project should bear its fair share of taxes and on the elimination of the most discriminatory features of the Lehman and Buckley bills. Public power advocates, by their rejection of Niagara Mohawk's efforts, are pursuing a policy which may further delay construction of the project.

"The companies have never abandoned their conviction that the project should be developed by private enterprise, and Central Hudson reaffirms its support of the Miller-Dondero bills which have been introduced in the House of Representatives to authorize private enterprise to undertake the project."

Charles B. Delafield, Con Ed

"In the light of the continuing deadlock on Niagara power," said Charles B. Delafield, vice-president of Consolidated Edison Co of New York, "any suggested solution should be carefully examined. We remain opposed, however, to the Lehman bill or to any other federal legislation which would dictate to the State of New York the policies to be followed in the transmission and sale of power from Niagara.

"We continue in our conviction that the Miller bill, permitting the development by established tax-paying electric business, is the sound and proper solution.

"But now it appears that the Miller bill cannot become law at this time, and the potential power of Niagara should be developed in the interests of all the people."

VEPCO Line Progresses

The first leg of Virginia Electric & Power Co's new 230-kv, $4.5 million transmission line has been completed. When the entire 93-mile stretch (linking the Chesterfield and Possum Point stations) is finished, it will replace a 110-kv line to help balance the load between the heavy industrial Richmond area and the thickly populated Alexandria-Arlington fringe of Washington, D. C.

Politics Ensnare Mexlight

Mexican Light & Power Co lost a decision to Mexican nationalism recently as Pres Adolfo Ruiz Corines—for political expediency—awarded the Federal Electricity Commission a concession to build a hydroplant only a few miles from Mexlight's Necaxa plant in the State of Puebla.

This was considered a slap in the face to Mexlight and private capital. Despite geographic suitability of the site and the fact that power is to be sold to Mexlight, the president reportedly said privately that it was "politically impossible" to permit Mexlight to build the plant.

Mexlight, predominantly owned by U. S., Canadian, Belgian, and Mexican capital, offered no public comment. It long has been pushing for rate increase sanction of Mexico's government. Mexico, it is understood, will have to borrow funds to build the plant. Mexlight had offered to build the plant with private funds.

Kitimat Loses Water Head

Aluminum Co of Canada officials have confirmed that the 10-mi Kemano tunnel in its British Columbia project will have to be unwatered to reveal why turbines at the Kitimat smelting plant are not getting enough pressure.

Officials in Vancouver would not say what the actual decrease in water flow has been because measurements were not complete. But they felt that "an obstruction near the center of the tunnel" may have closed off an access tunnel. It is thought that a rock fall may be the cause.

Appliance Sales Booming

Retail sales of major home appliances will top 18 million units in 1956 and may equal the 1955 record, Judson S. Sayre, president, Norge Div, Borg-Warner Corp, said at a recent appliance show in Chicago. What appears to be sales sluggishness is actually a top-heavy inventory caused by over-production, he said.

At the show, Hotpoint announced its entry into radio and TV field, Frigidaire displayed a model kitchen with such electronic trimmings as an electro recipe file, Gibson showed a vertical broiler that slides into the oven on runners for top unit, Kelvinator revealed its entrance into electronic range field, and other companies announced additions and improvements to their existing lines.

Federal Atomic Insurance

The picture is brighter on the government's insurance of nuclear projects. The Joint Atomic Committee has approved legislation that would make the government good for a $500-million liability should a disaster occur. This would augment the $65 million covered by private insurance companies. The approved measure now goes to Congress for voting.

The proposed measure (S 4112) amends the Atomic Energy Act of 1954 and authorizes the Atomic Energy Commission to charge licensees $30 a year per 1,000 kw of thermal energy capacity licensed under Section 103 (commercial projects), but less for projects under Section 104 (research and development), and for construction permits under Section 185.

Sworn In: Hamil to REA . . .

ADMINISTERING OATH OF OFFICE to David A. Hamil (right), new head of Rural Electrification Administration, is the Secretary of Agriculture, Ezra T. Benson

and Kline to FPC

ARTHUR KLINE (right), former Wyoming district judge, is sworn in as Federal Power Commission member by Federal District Judge E. T. Kerr for a 5-year term

CIGRE INSPECTION GROUPS at Fontenay testing station outside Paris. They saw 220-kv cable under long-time load cycle tests, also samples of submarine cable being studied for use in a Britain-France tie under the English Channel

DC Transmission Revived at CIGRE

Success of Gotland cable after two years operation spurs Swedes to extend use. British hint dc use in cable under channel. Russia planning dc interconnection. Extension of ac voltages above 400 kv seen as practical. Swedes say 650 kv is limit for present technology. RI remains problem

J. H. M. SYKES, Bedford, England

Twin technical highlights of the 1956 International Conference on Large Electric Systems (CIGRE) at Paris early last month were these:

- Greatly revived interest in high voltage direct current transmission.
- First suggestion—from Sweden—that commercial use of ac voltages above the 380/400-kv level is being considered.

The CIGRE Conference grows each time the two-year period comes round. This time there were around 1,700 members. A strong American delegation was led by H. L. Melvin, chief consulting engineer, Ebasco Services, Inc. This year too the U.S.S.R. delegation was considerably larger, and its members were infinitely more cooperative. All was smiles and invitations to visit Russia. No technical information appeared to be withheld.

On the first technical highlight: American engineers had little to say on high voltage direct-current power transmission; but they were nevertheless present in force at the dc session. The Swedes, who in 1954 pioneered the world's first commercial dc transmission between the Island of Gotland and the mainland of Sweden, 62 miles distant, announced that they are very probably converting to dc some of their 220-kv overhead 50-cycle lines to enhance load carrying capacity.

Japanese brought forward proposals for dc submarine cable power transmission between the islands of Japan. They were particularly prominent in the discussion of papers presented to the dc session. One such paper, by British and Swedish authors, presented for the study committee on this subject, gave a detailed cross comparison between ac and dc for various transmission projects. This paper showed that the dc system calls for a certain minimum transmission distance before it can become competitive. For an overhead line and straight-through transmission from a power plant to a load center, cost curves for ac and dc intersect at 320 miles for 1,500 Mw and at 390 miles for 750 Mw. But for submarine cables the cost curves intersect at 22 miles for 750 Mw and at 18 miles for 100 Mw.

Because the dc link is not synchronous, regulation of the power flow can be effected independently of the frequency and voltage of the connected ac networks. This feature may be of very considerable economical importance in certain cases, it was

noted. Short circuit stresses in connected ac networks are reduced. Further cost reductions in both ac and dc transmission are to be expected. But they will be greater for dc.

A Russian paper presented late and not therefore included in the numbered papers showed that the Russian engineers have been operating for nearly five years a commercial-scale dc system between Kashira and Moscow, using two single-core underground cables for a distance of 112 kilometers. The voltage between poles is 200 kv, and the transmission capacity is 30 Mw.

Soviet Plans Large-Scale DC Line

In the U.S.S.R. 500 engineers are engaged on high voltage dc research, and there are active plans for a large-scale dc line to interconnect the Stalingrad hydroelectric plant with the Donbass region. This project is to be completed by 1960. It is proposed that as a result of the tests already carried out on the Moscow-Kashira line and the experience gained in the construction of a major overhead line project, such as the Donbass-Stalingrad link, that future very-high power lines over the great distances of up to 1,000 miles between the enormous hydroelectric potential in Siberia and the more industrial regions of the U.S.S.R. will all be operated on the dc system.

Britain-Europe Link to be DC

From Britain there came a guarded announcement about the cross-channel power link to couple the British Isles with the European network. Although no official pronouncement has yet been made, it is understood that a definite decision has been reached that this link will be a direct current project. Outside the official conference room this writer gained unofficial news of very pronounced interest in dc power transmission in New Zealand and Canada.

On the high voltage ac side a summary of the present extra-high voltage development was offered by Philip Sporn, chairman of the CIGRE study committee in this field. He said that several tendencies could now be seen. First, there appeared to be no practical limitation at 400 kv as had sometimes been thought in the past. The Swedes, in a report presented to this section of the conference, and summarized by the Sporn committee, showed that a reconsideration of the characteristics of the 400-kv lines would permit both lines and switchgear to be employed for 500 kv after slight alterations.

Third Conductor Cuts RI

Radio interference problems could be solved by the addition of a third conductor per phase. The two now used—in bundle formation—have given no trouble in this respect at voltages up to 420 kv. The Swedes considered an operating voltage of 650 kv to be the practical limit of voltage. This voltage could be used, but it would mean complete redesigning of the system and might not be economical in a relatively small country. They are proceeding with detailed studies on increasing the voltage to 500 kv.

The Sporn summary went on to show that in France there will be 309 miles of line operating at 380 kv by 1957; in England the 275-kv supergrid system continues toward completion. In Switzerland studies on 380-kv lines have been completed, and the techniques are available when needed. In Australia 330-kv lines are under construction while in Germany 380 kv will be used for the first time in 1957. In the United States 1,127 miles of circuit are now in operation in the 330-kv class.

Extra-high voltage discussion showed that engineers are still greatly concerned with disturbances to radio and television networks by corona effect and insulator flashovers which take place in an unpredictable fashion. The Americans who intervened in this discussion showed a highly practicable approach to extra-high voltage transmission line design. They said that rather than rely on theoretical design considerations alone, several United States utilities plan to construct fullscale line sections for test purposes.

Use of Single Conductor Advised

P. L. Bellaschi, consulting engineer of Portland, Ore., sounded a cautionary note when he said that he thought there was too much tendency to concentrate on higher voltages before full consideration had been given to the capabilities of the existing high voltage lines. He thought that the single conductor system, instead of the bundle of two or more conductors commonly employed, was capable of being applied even up to voltages of 300 kv.

W. S. Price, research engineer of the American Gas & Electric Service Corp, differed from Bellaschi on bundle conductors. Laboratory tests on corona with single and bundle-conductors indicate, he said, that there is considerably less corona with the twin conductor arrangement.

There was much divergence of view as to the evaluation of radio interference from high voltage lines. Russian engineers said that there was reason to believe that there was a correlation between corona loss and the rainfall density in various parts of the network. R. E. Martin of Britain's Central Electricity Authority felt that interference measurements on power lines extended over far too narrow a frequency range. A German contribution indicated that in the view of Dr G. Lesch no instrument yet devised could be said to give an accurate measurement of interference levels.

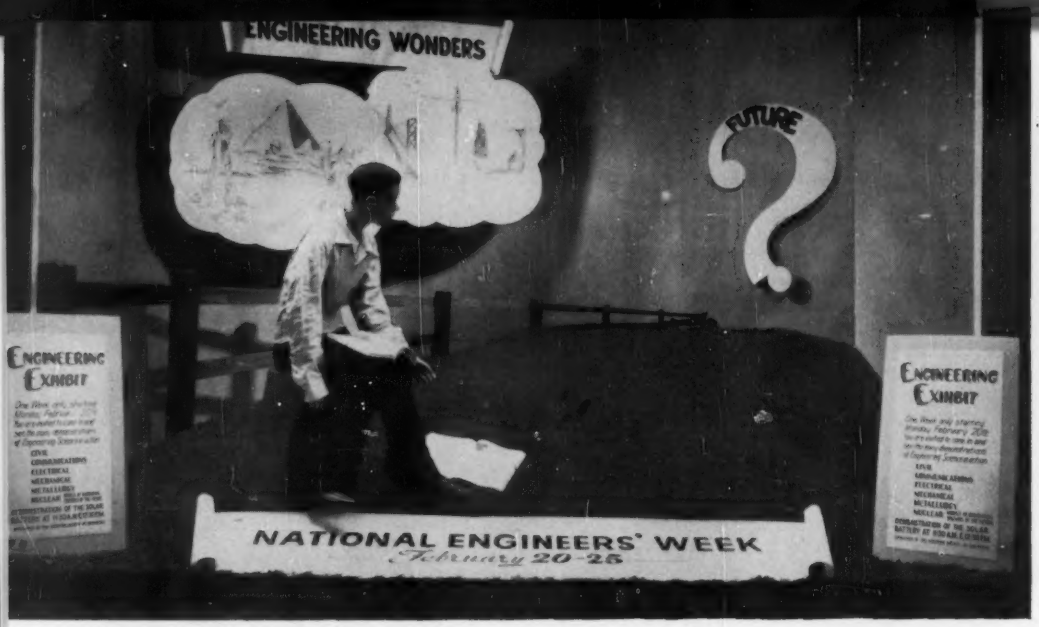
Cooling Problems Aired

A lesser point of interest at CIGRE was related to alternator problems. The question of cooling attracted a wide range of viewpoints. In Great Britain inner-cooling of stator windings was apparently forced on designers by the narrow-loading-gauge British Railway system and the low clearances on bridges and highways. The methods considered were the use of high pressure gas or liquid cooling for the stator conductors.

Views on Liquid, Gas Presented

The British conclusion appeared to favor the use of liquid as it seemed easier to design conductors for liquid rather than for high pressure gas. Alekseev, U.S.S.R., said he thought gas under pressure was best for stator cooling. He further felt there might be some advantage in separate systems of cooling for rotor and stator.

The American view was that there are several alternative methods of conductor cooling of generators. The paper which set forth the American view on this subject was by W. L. Ringland, Allis-Chalmers Manufacturing Co; C. E. Kilbourne, General Electric Co; and L. A. Kilgore, Westinghouse Electric Corp. It was said, in discussion, that it was possible to design sets up to 500 Mw by the use of conductor cooling and to ship a 350-Mw stator completely assembled and wound when gas pressure cooling systems were employed.



Chicago Exhibit Helps Boys, Parents Decide . . .

Should He Be an Engineer?

EDWARD STEEVE, Engineer, and **JOHN SCOTT**, Engineer, Commonwealth Edison Co, Chicago, Ill.

Chicago high school students and their parents soaked up the story of exciting careers and opportunities in engineering and science fields during National Engineers' Week. More than 12,000 visited exhibits set up at Commonwealth Edison Co's offices in the heart of Chicago's loop.

The tremendous interest shown assured the show's participants that visitors left with a better understanding of engineers and engineering.

The exhibit was sponsored jointly by Commonwealth, its Public Service Co Division, and Western Society of Engineers. Its aim was to present a panoramic story of what engineering is, what an engineer does, and the curriculum requirements for an aspirant.

The show's committee, made up of Society members and Commonwealth engineers, followed these steps:

1. Sent notifying letters to Chicago loop area school principals.

2. Sent show publicity to all Chicago daily newspapers and most of the local and suburban weeklies.

3. Obtained 2,000 sq ft of space on Commonwealth Building's first floor, part of which was converted into a theater seating 60 people.

4. Had young engineers man exhibits on engineering accomplishments.

5. Showed two movies on engineering careers in the theater (Eta Kappa Nu's "Engineering—A Career for Tomorrow" and Westinghouse Electric Corp's "Dawn's Early Light").

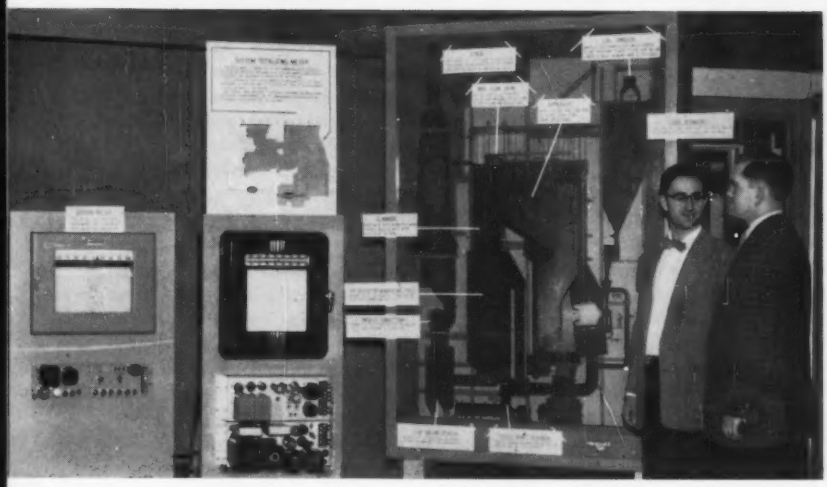
6. Had young graduate engineers pass out pamphlets on phases of engineering, answer queries at information booth.

7. Gave more than 300 youngsters guided tours through, and short lectures on the building's interesting places like the load dispatcher's office.

Other participating organizations were General Electric Co, Babcock & Wilcox Co, G&W Electric Specialty Co, Keuffel & Esser, Argonne National Laboratory, Sperry Gyroscope Co, Northwestern University, Illinois Institute of Technology, Illinois Bell Telephone Co, Okonite Co, Rome Cable Co, Nuclear Instrument Co and Westinghouse.

COMMONWEALTH Edison Co engineer explains transmission, distribution system by a detailed working model; protective relaying was featured

NUCLEAR ENGINEERING with emphasis on fuel elements, radiation detectors, is theme of working models of two reactors and utility's future Dresden Station nuclear plant



POWER SUPPLY display shows cutaways of boiler, turbo-generator. Commonwealth system's instantaneous generation is explained with assistance of recording meters

ENGINEERS who developed live line transient fault locater demonstrate how it works. More than 12,000 Chicago parents, high school youngsters saw the six-day show

Short-Circuit Problems Are Solved in Program to . . .

Revamp Breakers for Heavier Duty

R. O. BONINE, Power Circuit Breaker Engineering, Westinghouse Electric Corp, East Pittsburgh, Pa.;
L. R. SELLERS, Tennessee Valley Authority, Knoxville, Tenn.

As the capacity of power systems has increased during the last few years, so have short circuit currents. For power system operators this has posed the problem not only of matching circuit breaker interrupting capabilities to system needs but of keeping them matched.

Fortunately advances in design have made interrupters more efficient. Such improvements, coupled with the liberal size of older circuit breaker designs, make substantial up-rating of existing breakers attractive and practicable by in-place revamping.

Such revamping not only costs less than a new breaker of required capability, but it takes less time to get parts than to get an entire new breaker. Doing the work on the spot with available construction and maintenance forces provides a fine opportunity for training. It saves the cost of moving. And the modern operating characteristics secured by revamping an old breaker eliminate the problem of finding a place where an old unit can be reinstalled without modification.

Rebuild Breakers in Place

This was demonstrated recently by modernizing and up-rating from 3,500 to 10,000 Mva two 161-kv Westinghouse breakers at a customer's substation connected to the TVA system. Field work was done by regular maintenance personnel. Tests on the completed job, with new operating mechanisms and roller bearings throughout, demonstrated the breakers' ability to open in three cycles and reclose rapidly. These breakers had originally been installed 12 years ago and had seen substantial service.

Revamping to such a high capability required replacement of almost everything in the tanks but the current transformers. Surge suppressor chambers were welded into the tanks to absorb shock pressures of the new duty. Bushings were replaced with new heavy-duty condenser bushings. A new roller-bearing lever-and-linkage system and pneumatic operating mechanism were installed, and a manhole was cut into the tank wall for convenient entrance.

Special tools were needed to align and locate the new parts before welding. The special reamers and welding jigs needed were supplied by the manufacturer. The owner provided all the materials-handling facilities required for handling material at the work site. These facilities had to be capable of handling condenser bushings.

Tanks Stripped of Old Parts

Breaker tanks were first stripped of all parts to be replaced—condenser bushings, stationary and moving contacts, lift rods and guides, levers, pull rods, bell cranks, operating mechanism, and accelerating spring with housing. The mechanism and bell-crank mounting brackets were burned off the front tank. Care was taken when burning out the old lever system not to burn away too much material as a snug fit for the new lever box would decrease distortion while welding. The tank top could not be over-heated as current transformers mounted around each bushing flange might have been damaged.

The tanks were positioned, plumbed carefully, tied together, and anchored. The new lever box was installed by first locating it in position with a special fixture tool supplied by the manufacturer. This fixture accurately placed the new lever box in relation to the machined surface on the condenser-bushing mounting flanges in the tank top. After leveling, plumbing and centering, the new lever box was tack welded in several places, then the fixture was removed. The final oil-tight weld was made inside and outside, care being taken not to apply excess heat in any one place to prevent warping or distortion. The inside weld sealed cracks and joints to prevent welding spool and scale falling into breaker contacts.

The new bell crank housing was positioned with a fixture tool that located it from the main lever shaft after bearing holes were line reamed with a special shell reamer. The new bell crank was then welded in place and the main shaft bearing holes reamed. Surge chambers, manhole doors, operating mechanism mounting brackets, and float-type oil gauge mounts were welded in place.

After all tank welding had been completed, tanks were pressure tested for leaks in the new welded sections. It was necessary to fill the entire tank with oil to leak test upper extremities of the new lever box. To permit this, all open ports in the tank were tightly closed with gasketed covers. A short piece of ⅜-in. pipe with shut-off valve was mounted on the Cincinnati Time rod-entrance nipple on top of the tank to vent the air. Regular circuit breaker oil was used to leak test the tanks at 75 psi for 15 min. The new welds were wire brushed and painted with chalk whiting to show up leaks quickly.

Whenever leaks were detected in new welds, the oil level was lowered a few inches and at least one cover removed to open the tank to atmosphere. Before attempting to repair leaks the weld was gouged out and ground smooth with a duck carborundum wheel, leaving a 45 deg groove ¼ in. deep. It was rewelded, new whiting applied, tank refilled with oil, and retested. After the leak test had been completed satisfactorily, the tanks were drained and all covers removed.

Install New Mechanism

Complete new pole-unit and bell-crank lever systems were installed. The new bell-crank and pole-unit main fulcrum shafts were equipped with roller bearings. The main operating levers connecting the 3-pole units to a common horizontal pull rod also were fitted with roller bearings. The new levers were carefuly positioned, limited in the closed position by toggle and lift-rod stops and in the open position by hydraulic shock absorbers.

New condenser bushings then were installed, with gaskets properly positioned for a weather-tight seal. New Micarta lift rods and lift rod guides

were installed and plumbed. The new operating mechanism was placed in position and its mounting brackets tack welded while the overhead lifting facilities were still available. The operating mechanism was then permanently mounted, connected to the bell crank, and the proper travel adjustments were made. The stationary-contact adaptor castings were mounted on the lower end of the condenser bushings and the interrupters installed.

From this point on the procedure was quite similar to that for installing and adjusting a new breaker. Moving contacts were assembled one pole at a time and preliminary rough adjustments made until a total representative load was applied on all parts including the accelerating spring. Then a recheck was made of all contact and lever settings, and final adjustments were made to specified tolerances.

After all adjustments had been completed, a few preliminary operations were made to check adjustments under power operation. Hydraulic shock absorbers were prefilled with oil and a minimum power source for closing control used. A few mechanical operations under these conditions afforded an opportunity to check adjustments for travel, compression, and tightness. Then the tanks were cleaned, closed, and filled with oil.

Check Operation with Air

Operation of the complete breaker and mechanism was checked as soon as normal operating air pressure was available from the storage reservoir. Pneumatic operations verified an adequate number of operations with one storage reservoir of air. Minimum closing pressure was obtained automatically while making run down operations. Tripping operation was checked from minimum to maximum control voltage. Timing and travel curves were made with a suitable recording device closing, tripping, reclosing and trip-free operations. The operating mechanism and accelerating devices were adjusted to obtain satisfactory contact velocities and operating times to meet the required performance.

Pneumatic mechanisms are usually used for operating revamped circuit breakers, primarily because of their versatility. Use of roller bearings throughout and pneumatic operating mechanisms makes possible very high-speed first reclosure, multiple high-speed reclosing, and necessary acceleration of contact members to meet 3-cycle performance at 10,000-Mva interrupting duty.

This program grew out of the rapid increase in TVA generating capacity during the past 20 years. Growth has required almost continuous review of the adequacy of existing 161-kv breakers. When their ratings are exceeded, these four corrective methods are investigated:

1. Installing bus reactors.
2. Revising line connections to permit split-bus operation.
3. Replacing existing breakers with breakers of adequate ratings.
4. Rebuilding existing breakers to a suitable high rating.

Bus reactors have not been installed at any of the generating plants because of cost, space, and operating factors. Split-bus operation is used in two steam generating plants where the duty is such that the largest available breaker, 10,000 Mva, is not adequate. But this type of operation has disadvantages in flexibility.

Many Breakers Involved

Methods 3 and 4 have been used quite extensively. At present 357 breakers of the 161-kv class furnished by three manufacturers are installed in 20 hydro and 6 steam plants. Of the 113 breakers installed in the hydro stations, 72% have been revamped to higher interrupting capacity, and 27% have been transferred from other stations where they were replaced with new breakers of increased rating. There is some duplication in these figures since many of the transferred breakers have had improvement parts installed. In addition many breakers have been transferred to step-down substations.

All of the 1,500-Mva and many of the 2,500-Mva breakers originally installed have been improved to 3,500, 5,000, or 7,500-Mva ratings. In these cases the original bushings were retained, as were the pole-top boxes, except for one installation where breakers were revamped to 7,500 Mva. Practically all solenoid-type operating mechanisms were replaced with pneumatic-type as required by the heavier contact loading or to reduce interrupting and reclosing times.

The relative costs of improving existing breakers as compared to replacing them with new breakers varies widely as illustrated in the tabulation. All costs are in per unit of new breaker cost at the required rating.

Case A requires new interrupters, lift rods with guides, and operating mechanisms. It is advantageous to improve such breakers, particularly as it would be difficult to find locations for the 1,500-Mva rating.

Case B requires new pole-top lever boxes in addition to the parts required for Case A. Case C is similar to B, except that new replacement bushings are required to obtain mechanical strength. These breakers should be replaced if their high salvage value can be realized at other locations, otherwise improvement parts should be installed. For Case C credit for the replaced bushings may be in order.

Cost Comparison Guides Decision on Revamping

	Case A	Case B	Case C
Existing breaker rating, Mva	1,500	3,500	3,500
Required breaker rating, Mva	5,000	7,500	10,000
Install new breaker of required rating			
Breaker cost f.o.b. site	1.00	1.00	1.00
Installation on existing foundation	0.04	0.03	0.03
	1.04	1.03	1.03
Net salvage value replaced breaker	0.24	0.57	0.54
Total net cost	0.80	0.46	0.49
Improve existing breaker to required rating			
Improvement parts cost f.o.b. site	0.34	0.38	0.65
Installation of parts	0.05	0.06	0.06
Total installed cost	0.39	0.44	*0.71

*0.58 if credit is taken for replaced bushings.

4.16 Kv with Unit Subs Serves Pittsburgh Shopping Centers

DISTRIBUTION
Design

Duquesne Light finds that flexibility of system has made possible expansion to serve developments up to 4,000 kva

R. R. WEST, Senior Project Engineer, Engineering Department, Duquesne Light Co, Pittsburgh, Pa.

Despite the unexpected concentration of shopping centers in the Pittsburgh area, Duquesne Light Co's 4.16-kv primary system with 23-4.16 kv unit substations has proved adequate to carry the expanded load. And the system's inherent flexibility has enabled economical expansion to serve five widely scattered developments ranging to 3,000 kva each. Proposals to serve six other shopping centers disclose no need to depart from established practice despite estimated demands approaching 4,000 kva.

4.16 Kv System's First Test

First test of the unit-substation, 4.16-kv system for service to large shopping centers came in 1953 with a request for 2,280 kva to supply lighting and air conditioning at Miracle Mile, 14 miles east of Pittsburgh. Earlier developments already were drawing 300 to 1,500 kva from 4-kv distribution, taking 120/208-v service from one or more transformers in vaults or on pole platforms. But the prospect of 2,280 kva of concentrated load in a rapidly expanding area where existing 4 kv was already loaded to capacity called for review of connection practices.

Two methods were considered for serving Miracle Mile and comparisons made as to first cost, ease of expansion, maintenance problems, public safety, and conformance to overall plans for the general area. One method was to loop a 23-kv circuit through a switching station on shopping center property and install a 23-kv regulator to maintain voltage on a tap supplying transformers adjacent to the larger stores. These transformers were to reduce voltage directly to 120/208.

23 Kv Looked Promising

The other method was to loop a 23-kv circuit through a substation site on shopping center property to a unit-type substation. A 4.16-kv circuit would supply transformers at various locations and also connect through normally-open tie switches to two adjacent 4.16-kv circuits.

At first glance 23-kv distribution and transformation in one step to utilization voltage looked promising as to first cost and simplicity of circuit layout. But because the 23-kv system in the area supplies unregulated service to heavy industrial loads, a 23-kv regulating station would be needed in the tap to the shopping center. Installation of this regulating station with the necessary switching and protective accessories would bring cost for this system up to the 4.16-kv system level besides introducing some operating and maintenance problems for which new procedures would have to be set up. Also the 23-kv-to-120/208-v transformer installations adjacent to the stores would require higher structures for clearance and more ground space for enclosures. Consideration of these points culminated in decision to use the 4.16-kv system to serve Miracle Mile and other shopping centers.

A permanent easement was obtained at the rear of the property for a 2,000-kva, TCUL, unit-type substation and a 23-kv overhead circuit looped through it. A 4.16-kv overhead main was installed along the rear of the shopping center and ties made to adjacent 4.16-kv circuits with sectionalizing switches.

What Developer Contributed

The developer provided concrete pads and fence enclosures at the rear of the five larger stores. Two 3-phase transformers were installed on each pad, one for 120/208-v, 4-wire lighting, and small motor loads and the other for 240-v 3-wire large motor loads. Only the five largest stores require separate 230-v 3-phase power connections. These power services and 120/208-v lighting were connected directly at the transformer terminals. All other stores of the center have 120/208-v service with overhead drops from service poles at transformer enclosures. All meters are installed on outside rear walls of stores and grouped where possible.

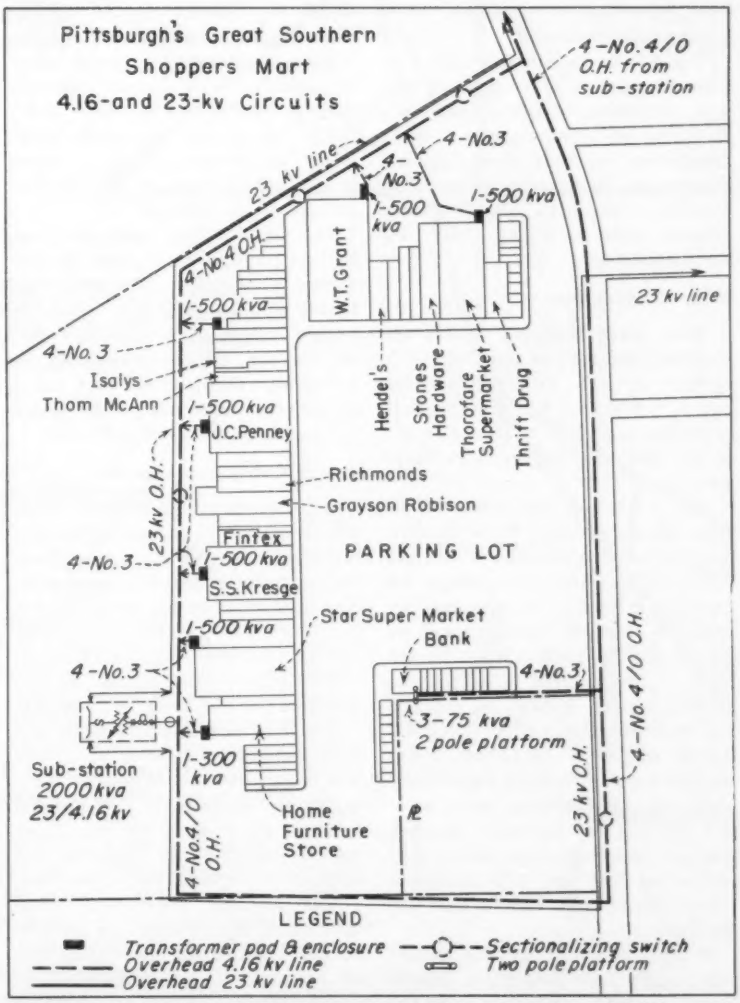
SECONDARY MAIN ON POLES behind stores is aerial cable supplied by slab-mounted 3-phase distribution transformers. Service drops are cable or open wire depending on load. Open-wire-primary ends at pole inside transformer enclosure

The 4.16-kv lines were brought to transformer enclosures with overhead wires. Lightning arresters, cutouts, and potheads are on the terminal poles. Lead cable runs down the pole to primary wiping sleeves on the transformers. Subway-type 3-phase network transformers were used on these surface installations because they were available at the time.

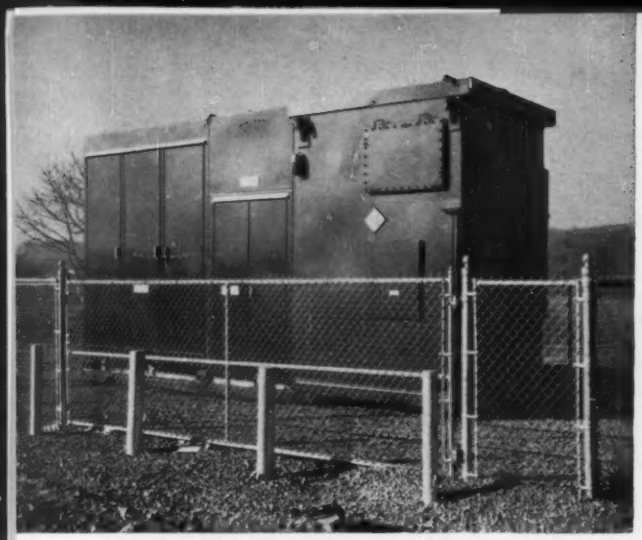
Other Projects Refined System

Subsequent shopping-center projects have provided opportunity to develop the system further. Pittsburgh's Great Southern brought a demand of 3,000 kva for 70 stores. Again a 2,000-kva 23-4.16-kv TCUL unit substation was used but with provision for a second unit when load exceeds the capability of the first plus capacity that was available in an adjacent 4.16-kv distribution circuit.

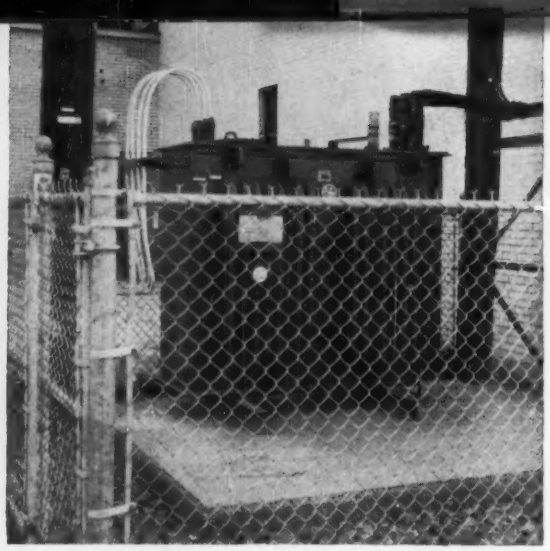
In this case 3-phase outdoor-type 4,160-120/208-v distribution transformers were used, except on a two-pole platform which supports three 75-kva single-phase units. Combined light-and-power secondaries are run with 600-v self-supporting aerial cable on poles at the rear of the stores. Cable is single conductor, 350 MCM copper with oil-base rubber insulation and Neoprene jacket, bound to a 4/0, hard-drawn copper neutral messenger. Service drops are of similar cable or weatherproof wires depending on the



PITTSBURGH'S GREAT SOUTHERN SHOPPERS MART has 3,000 kva of lighting and air conditioning in 70 stores. Plan shows 4.16-kv primary ring around the site



UNIT SUBSTATION combines 2,000-kva 3-phase 23-4.16-kv TCUL transformer with circuit breaker in one enclosure



3-PHASE TRANSFORMER has 120/208-v secondary serving groups of stores. Primary is 1-conductor lead-covered cable

load. Meters are on outside rear walls, grouped where possible.

The 4.16-kv main is 4/0 open wire with tie switches to an adjacent circuit. Overhead laterals extend from this main to terminal poles at each transformer enclosure where lightning arresters and fuse cutouts are installed. Primary connections are 1/c lead-covered cable to wiping sleeves on the transformer.

More Centers Due

Three more shopping centers are scheduled for completion in late 1956 or early in 1957. Estimated load for one is 3,890 kva, but it is planned to use the same type of service layout as was used at Great Southern Shoppers Mart.

One 2,000-kva 23-4.16-kv TCUL unit-type substation is to be installed originally with provision for a second 2,000 kva unit when load exceeds the capacity of the first unit plus capacity available from two adjacent 4.16-kv circuits. Six 500-kva and three 300-kva 3-phase outdoor type 4.16-kv transformers will be installed on concrete pad enclosures to provide 120/208-v 4-wire combined light and power secondaries. A 500-MCM hard-drawn-aluminum self-supporting aerial cable will be used for secondary distribution on poles behind the stores. Self-supporting 4/0 and 1/0 aluminum service drop cables will be used for the services.

Another of these shopping centers will require 1,500 kva for a department store branch which is to be the central unit. Two transformer vaults under the sidewalk at the rear of store will house two 500-kva and one 300-kva submersible power-center transformers with integral metering current transformers to supply 120/-208-v for lighting and small motor loads. A 450-hp compressor motor will be served direct at 4.16 kv and metered at that voltage.

One set of 4.16-kv lead cables will be brought into each vault. In one vault a 500-kva and a 300-kva transformer will be connected. In the other vault a 500-kva transformer and service for the 450-hp motor will be connected. Three oil switches and a tie between vaults will permit service restoration in event one cable fails.

Aerial Cable Secondaries

Other stores in the shopping center will be served by self-supporting aluminum aerial cable secondaries from 3-phase transformers on concrete pads. The primary main will be 4/0 open-wire from two 2,000-kva 23-4.16-kv TCUL substation units on the property. Excess substation capacity will reinforce the adjacent 4.16-kv system.

The third new shopping center will have the stores connected with malls and canopy-covered sidewalks. Estimated load is 3,680 kva. Underground facilities are planned for this center because the developer requested that no pole or overhead lines be installed.

The developer will provide space adjacent to the parking area for substation facilities and two 2,000 kva 23-4.16-kv TCUL transformers will be installed for the shopping center and other loads in the vicinity. The developer will build underground transformer vaults at seven locations and provide meter and switch rooms for services to the stores. Underground conduits will be installed from vault to vault and to terminal manholes to accommodate a 4.16-kv feeder cable.

Duquesne Light will install nine 500-kva 4,160-208/120-v subway-type power-center transformers to provide 3-phase 4-wire service and 4.16-kv cable from the substation through each vault to complete a loop around the shopping center. A subway-type oil switch will be installed in each vault so that each transformer and section of cable between vaults can be isolated in emergency. An existing 23-kv overhead circuit will be looped into the substation by underground cables, and 4.16-kv circuits will be brought out with underground cables to terminal poles outside the shopping area. Sectionalizing switches on the overhead portion of the 4.16-kv circuits will provide ties to an existing circuit in the area.

Future Centers Unpredictable

No prediction can be made as to type and size of future shopping centers or where they may be located. But the 4.16-kv system and unit-type 23-4.16-kv substations will be used where it is feasible and where this method coincides with overall expansion plans for the distribution system. Direct transformation from 23 kv to utilization voltage will not be overlooked, however, in future studies of service facilities for large shopping centers.

A Special Report

As expanding power systems gnaw into existing transmission reserves . . .

As suitable rights-of-way dwindle and the congestion of transmission lines mounts, now . . .

More than ever modern utility management is turning to . . .

Extra High Voltage

Today's Best Transmission Investment

DAN BRAYMER, Managing Editor

In the higher transmission voltages, today, lies the tool for restoring and maintaining the balance between expanding generating capacity on the one hand and dwindling transmission reserve on the other. Here too lies the means of stemming the mounting cost of rights-of-way and of keeping down the basic costs of transmitting the large blocks of power that are tomorrow's heritage.

In this special report there is ample proof that American engineering managements have recognized and embraced both the opportunities and the challenges that are inherent in extra-high voltage transmission for overhead and cable application

Here too is to be found evidence that utilities and electrical manufacturers alike have taken an eminently practical approach to the problems encountered by the pioneers of extra-high voltage in this country. In the following pages are to be found accounts of new research stations and test lines being established where the unresolved questions of radio influence, corona effects, bundling, and minimum conductor size will be explored.

In the articles that follow are reports of successful extrapolation of established design and records of the things that failed. This is the stuff of which progress is made. This way lies the promise of tomorrow.

EHV Feasible on 1,000 Mw Systems

Growing systems with large plant and unit sizes are turning to extra high voltage to meet right-of-way problems and to reduce circuit congestion

S. B. GRISCOM, Advisory Engineer and
MILES MAXWELL, Electric Utility Engineer, Westinghouse Electric Corp, East Pittsburgh, Pa.

Voltages up to 440 kv are technically and economically feasible today on any system in this country whose total power is upwards of 1 million kw. More companies can be expected to use EHV, including those with almost metropolitan-type systems. For these, EHV offers a solution to right-of-way problems and an alternative to many circuits for moving power from large generating stations.

Such companies are investigating the practicability of large plant and unit sizes, and the advantages of high-capability system interconnections. These are major considerations persuading a company to go to higher voltages. Transmission distance, formerly the primary reason for higher-voltage lines, is a less decisive factor on power systems today.

Increasing transmission-line voltages beyond levels in service, however, involves careful study of radio influence, line insulation, maximum kw loadings of circuit, possible necessity of sleet melting, and tower design. From a system standpoint the economics of the various voltages is the primary factor in selecting one of them. The economics of electrical power transmission is governed by these elementary points:

1. The load-carrying ability of a transmission line is proportional to the square of the operating voltage.

2. The transmission-line and terminal equipment costs rise rapidly with voltage, but more like the first power rather than the square.

3. As a consequence of points 1 and 2, the investment cost of transmission decreases as the voltage increases, provided that the full capacity of the high-voltage line can be utilized.

4. Inclusion of the capitalized loss further improves the economy of higher-voltage lines.

The first three points are self-evident; the fourth takes some explanation. For operation at any given multiple of surge impedance (SIL) there is no difference in the kvar and voltage regulation requirements of lines at various operating voltages. This follows from the fact that the reactance of a 3-phase line (single conductor per phase) is substantially 0.8 ohm per phase per mile at 60 cps regardless of voltage, and charging kva is proportional.

When conductor outside diameter is sized to satisfy radio influence and corona requirements, progressively larger OD's are involved. For ACSR, conductivity goes up as the square of the OD. Even with "expanded" conductors, conductivity increases rapidly with any increase in voltage.

But in the concept of SIL loading, rated line current and rated voltage must increase at the same rate. Consequently, increased conductivity is actually required as the voltage increases. But for lines operating at the same SIL, per-unit losses are proportional to r/x, r being conductor resistance per mile. Percentagewise, therefore, the I^2R loss becomes more and more favorable as the operating voltage is increased.

Effect of Corona Loss

Corona loss, though a little more complex, is probably a slightly lower percentage of load as operating voltage increases.

Transmission cost per kw, it has long been known, can be decreased through the use of higher voltages when higher loads per circuit can be used. The question then is: Can the economy be improved above that afforded by the square law?

Besides improved tower design, not considered here, the controlling items are conductor size and line insulation. Both were considered in "Parameters of EHV Transmission" (EW, July 11, 1955, p 104). Against this background absolute costs can be approximated and relative costs determined accurately for transmission lines at various voltages.

For transmission lines the major material costs are tower and tower footing steel and conductors. The erected cost of conductors and steel was determined as accurately as was practicable. The cost of footing, insulators, hardware, and ground wires was estimated from scattered data. Right-of-way, engineering, and supervision costs were estimated.

The cost of items constituting a transmission system may vary greatly over a period of time. Costs for one system or one area may not apply to other systems or other regions. But the relative cost should not vary too much. Consequently, the cost curves show relative costs,

FIG 1—Cost of Single and Double Circuit Lines

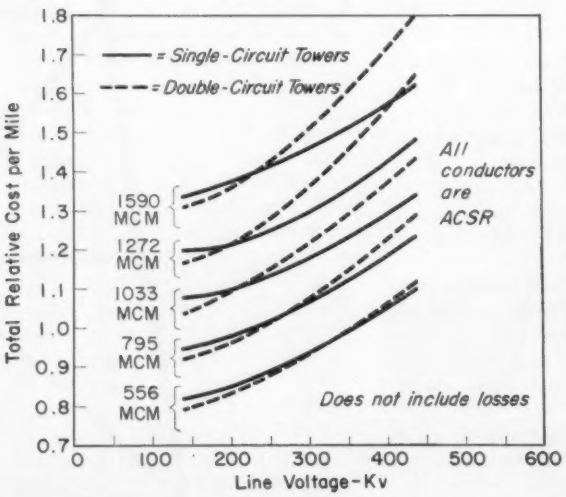


FIG 2—Line Cost per Mile vs Operating Voltage

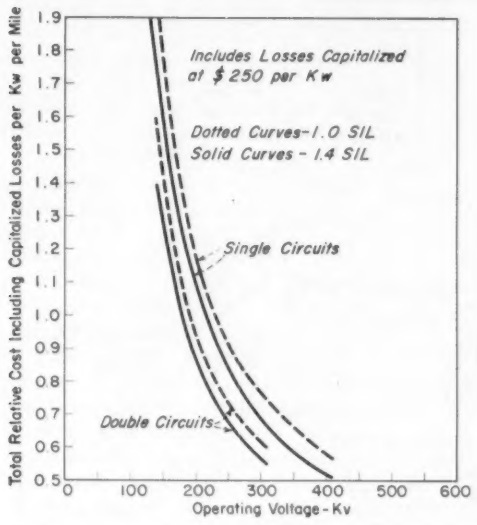
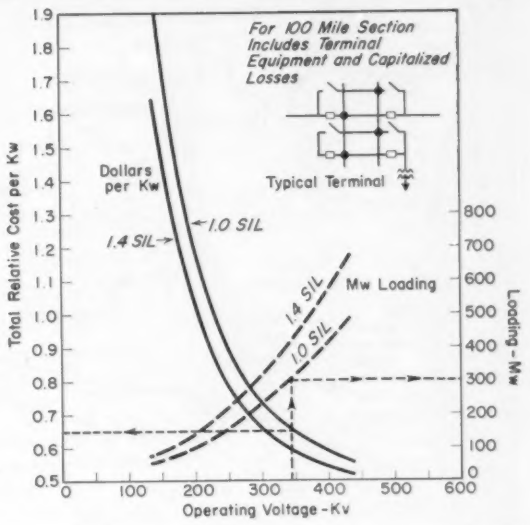

Total Relative Cost Including Capitalized Losses per Kw per Mile
Includes Losses Capitalized at $ 250 per Kw
Dotted Curves-1.0 SIL
Solid Curves - 1.4 SIL
Single Circuits
Double Circuits
Operating Voltage - Kv

FIG 3—Total Line Cost and Loading vs Voltage



and there is no relationship between the per-unit values of the different sets of curves.

Evaluated losses being so important in the selection of conductor and voltage, a value of $250 per kw of peak load loss was used in Figs 2 and 3. This figure is fairly typical for capitalized transmission-line losses, and several reasonable combinations of demand charge, energy charge, carrying charge, and load factor give values of this order. The resultant line investment costs, not including capitalized losses, appear in Fig 1. Obviously, some small conductors are not usable at high voltages because of radio influence and corona. In general, capitalization of line losses is subject to wide differences depending upon:

1. Operating loads in terms of SIL.
2. Whether the proposed lines are essentially single-purpose for one-way transmission where the demand charge for peak losses is high, or grid (interconnection) lines where demand charges should be low.
3. Load or loss factor on the lines.
4. Demand charge.
5. Energy charge.

Many Combinations Possible

There is almost no limit to the combination of items, but it was decided that numerous approaches only confused the interpretation. The results are presented in Fig 2, with losses capitalized at $250 per kw of peak load loss. Two values of loading were used, SIL = 1.0, and SIL = 1.4.

Conductor sizes were optimized for evaluation of the losses occuring at the SIL's used, without regard to the radio influence level. At 345 kv and above the optimum conductor may be deemed by some utilities as having too large r.i. values.

Kvar correction was not evaluated. This item is not greatly different at different voltages for the same SIL loading. The economics of operating at low SIL loading with small kvar correction compared with a high SIL loading with appreciable kvar correction, will have been established by ac network calculating board investigations.

Fig 2 shows that evaluated transmission-line costs drop lower as voltage increases. This is a consequence of the assumption that, at each voltage, the line operates at a given SIL load. Hence the actual load increases with voltage. Actual kw loadings must be considered to obtain the true economic picture, and apparatus cost must be included.

Grid System Assumed

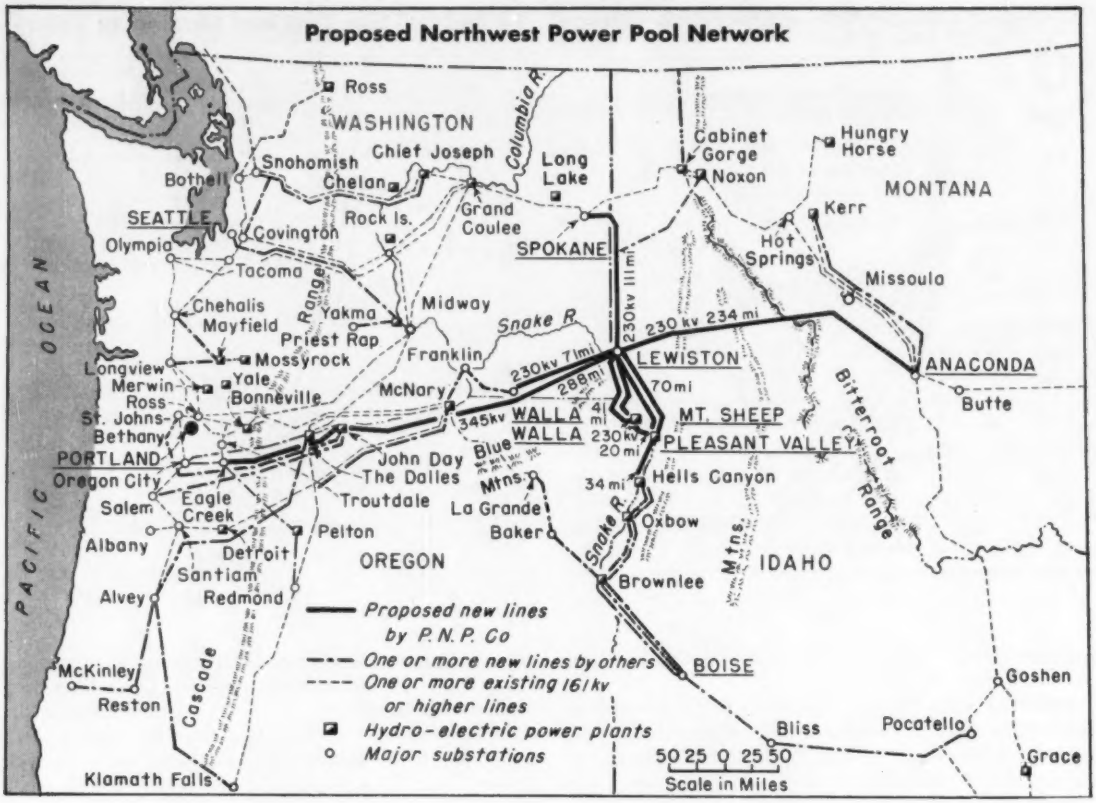
To obtain a realistic balance between transmission and equipment costs, a grid-type system was assumed. In this system a line goes across country. At 100-mile intervals is placed a step-down/up station wherein transforming capacity is half the kw loading of one line section. A 345-kv line at SIL = 1.0 serves as an example. The cost elements included are these:

1. 100 miles of 345-kv line.
2. 140,000 kva of transformers.
3. Four 345-kv circuit breakers.

Results at any given line voltage were plotted in multiples of the circuit loading. At 138 kv the plotted points are 48,000, 96,000, 144,000, etc kw. Double-circuit lines were used for even numbers of lines up to and including 345 kv.

Transformer and circuit breaker costs were estimated from equipment plus installation cost. The number of breakers at each 100-mile interval was twice the number of lines plus two. A graduated scale was used for breaker interrupting capacity. This reached 40-million kva at 400 and 460 kv.

The results are in Fig 3 where cost per kw-mile continually decreases as voltage increases. This economy is realizable only when loadings per circuit follow the corresponding dotted curves. The curves flatten out at the higher voltages, seeming to indicate a rapidly diminishing economic return. This is not strictly true. In the 150 to 200-kv zone, cost decreases 28%. In the 300 to 400 kv zone—an equal percent increment of voltage—cost decreases 21%.



Plan 345-230-Kv System for NW

To integrate Mountain Sheep-Pleasant Valley Project with transmission grid of Northwest Power Pool study shows:

- **345 kv feasible for 288-mile line because of distance, amount of power, and size of interconnected system**
- **230 kv is best for 698 circuit miles because bulk of power goes four different directions rather than one**
- **Twin bundle conductors favored for 345-kv line**

W. A. MORGAN, Planning Engineer, Washington Water Power Co, Spokane

A transmission system that would have 288 miles of 345-kv and 698 circuit miles of 230-kv lines has been proposed by the Pacific Northwest Power Co. Designed to transmit power to load centers from the Mountain Sheep-Pleasant Valley project on the Snake River, this system is shown in Fig 1 and was described in an AIEE paper,* last month.

Pacific Northwest Power Co was organized by Montana Power Co, Pacific Power & Light Co, Portland General Electric Co, and Washington Water Power Co. The transmission study in the joint endeavor was assigned to Washington Water Power Co.

The study summarized in this article was a detailed economic and technical analysis of alternate routes, transmission voltages, conductor sizes, and structural designs. Application of 345-kv transmission was investigated using single-large or double-conductor design and high-strength steel and wood-pole as well as conventional steel structures.

Use of 345 kv was found justified for the 288-mile Lewiston-Portland line (Fig 1) because of the long distance and the large amount of power that it would transmit. Use of two bundled 795-MCM ACSR conductors on 18-in. spacing appears justified for this line on a preliminary basis. However more detailed studies of erection, ice-loading, and other problems remain to be made.

Wood-pole design for the 230-kv transmission lines was found most economic and applicable in the relatively dry climate. And 1,272 MCM ACSR conductor proved desirable for heavy loading.

The proposed transmission system would be fully integrated with the grid of the Northwest Power Pool. It would interconnect the proposed Mountain Sheep and Pleasant Valley power

*"Transmission Planning for Mountain Sheep-Pleasant Valley Project," by W. A. Morgan, G. R. George, R. C. Guse, and M. F. Hatch, presented as a conference paper at the AIEE Summer and Pacific General Meeting at San Francisco, June 25-29, 1956.

plants with the principal load centers of the four organizing companies at Portland, Ore.; Walla Walla, Wash.; Lewiston, Idaho; Spokane, Wash.; and Anaconda, Mont.; and with the system of the Idaho Power Co at Hells Canyon. An additional tie to the grid would be made at McNary or the proposed John Day power plants.

Mountain Sheep and Pleasant Valley power plants will have initial capabilities of 333 and 850 Mw respectively, for a total initial capability of 1,183 Mw. Corresponding ultimate capabilities would be 432 and 1,014 Mw for a total of 1,446 Mw.

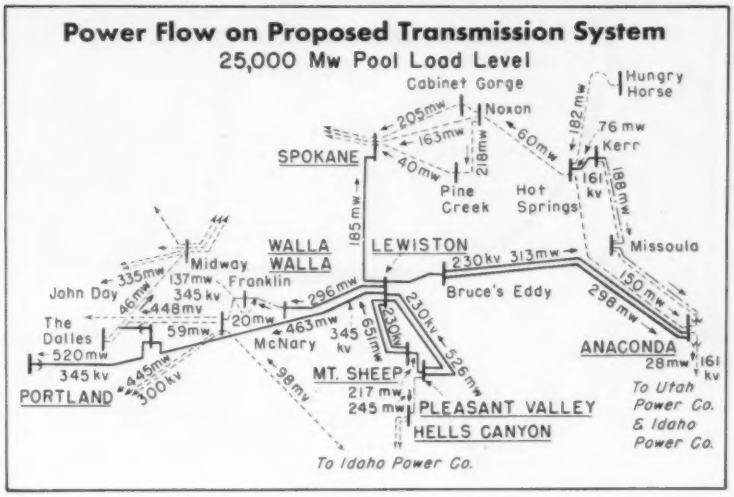
First step in designing a transmission system for the project was to determine the ultimate Northwest area (power pool) transmission system needed in the future. This determination would provide a pattern in which the lines required for initial and intermediate development should fit. Moreover, it would avoid building lines for intermediate load needs that would not carry economic loadings in the future interconnected network.

Study Needs for 25,000 Mw Peak

A Northwest Power Pool peak of 25,000 Mw was chosen as the load level that would require the maximum transmission system. At this level the output of most of the feasible major hydroelectric projects would be required. Hydroelectric plants were assumed to be the primary source of power so long as economical new sites were available. After that steam-electric plants would be built, many of them at load centers on the coast where tide water fuel delivery would be available. The trend will be for more hydro power to be absorbed inland, reducing amounts transmitted to the coast.

The November 1955 winter peak load of 8,668 Mw caused many to believe that a 25,000-Mw peak may be reached in less than 20 years. But possibility remains that large blocks of industrial load or other factors will affect the relative growth of different areas. This was taken into account in testing the proposed system by shifting 500 Mw from Seattle to Portland and vice versa for the 25,000-Mw load level, and a lesser amount for an intermediate load level.

To study intermediate load and development levels with divergent resource location assumptions, pool peak load levels of 15,000 and 13,000 Mw were picked.



• The 15,000 Mw level was assumed to result when a John Day plant of about 1,270 Mw and a Priest Rapids plant of 610 Mw would be in use.

• The 13,000 Mw level was corresponded to the level without them.

Object of these two sets of assumptions was to use the extreme requirements which might occur in the intermediate stages of development of the transmission system ultimately required. This arose from the difficulty of setting a definite order for the addition of new generation.

A total of 111 power flow cases and two transient stability cases for the five loading conditions were studied on the ac calculating board. Space does not permit a detailed presentation of all of the various alternate arrangements considered.

Fig 2 shows a partial diagram of the power flow over the proposed transmission lines for the 25,000-Mw pool peak load level, when the Mountain Sheep and Pleasant Valley plants would have the ultimate development of 1,446 Mw. All proposed transmission lines would carry adequate loads at this ultimate system loading condition. The interconnection of the 345-kv Lewiston-Portland line to John Day Plant does not change the loading on the line materially, but it does improve the reliability and stability of the network. Future power plants on the Snake River, downstream from Lewiston, were assumed connected to a network between Midway and Lewiston at this local level. Lines between Bruce Eddy and Lewiston are omitted.

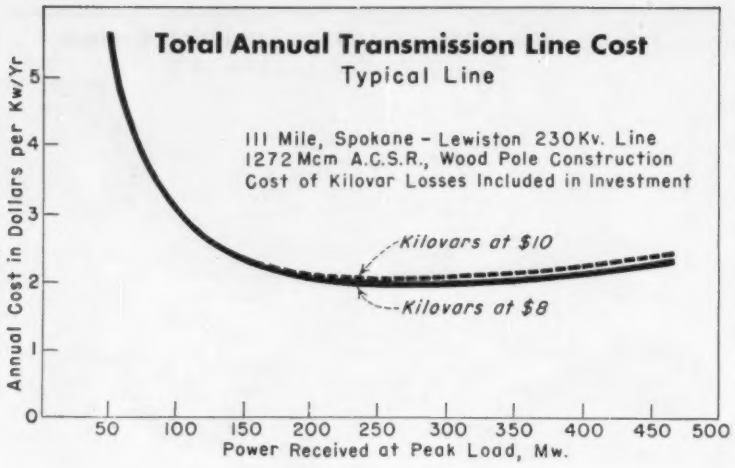
Because the amount of power (1,446 Mw) is large and the transmission distances great, it was first thought that an all-345 kv system may be justified. Accordingly preliminary line and equipment costs were prepared for the various alternatives for both 345 kv and 230 kv.

Annual costs, including losses of an all-345-kv plan would be about $1,500,000 more than the 230-kv plan for the initial development when only one 230-kv Lewiston-Anaconda line would be required. For the ultimate development, when two 230-kv Bruces Eddy-Anaconda lines are required, the total annual costs would be about equal. Thus, the all-345-kv plan could be considered only for the ultimate development.

All 345-Kv System Rejected

Basic reason an all-345-kv plan is not the most economical for this project is that power is transmitted in four directions. The power flows west to Portland and Walla Walla, north to Spokane, east to Anaconda, and south to Hells Canyon in the 25,000-Mw load level. With this situation it is not possible to take advantage of the economics of single-direction flow, over long-distance, straight-away transmission between the power plant and the load center.

Another attempt to justify 345 kv transmission was made for the lines between project plants and Lewiston substation. It was reasoned that perhaps the straight-away transmission of 1,200 Mw in this one single-direction toward Lewiston would justify 345 kv, and the dispersion of the power in three directions toward Walla Walla, Spokane, and Anaconda would



be by 230 kv. On the same comparative basis as before, it was found that the 345-kv plan would have annual costs of over $400,000 a year more than the 230-kv plan for the 25,000-Mw pool peak load level because the transmission distance is short and the higher costs of 345-kv terminal equipment outweigh the savings in transmission.

Thus, for most of the system, 230-kv transmission lines are justified over 345 kv because the power has several directions to go instead of one and because the single-direction flow-distance is short. The 288-mile, Lewiston-Portland line is justified at 345 kv because of the long distance and the large amount of power it transmits.

Study Series Compensation

During calculating board studies, it was assumed that the 345-kv Lewiston-Portland line would use one 1,780.7-MCM ACSR, 1.6-in. conductor per phase. But it was found that this line would transmit about 50 Mw more power if it were compensated for 25% of its reactance. This compensation could be accomplished either by an installation of 345-kv series capacitors in the single conductor line or by substituting two 795-MCM ACSR conductors per phase spaced about 18 in. apart connected as a "bundle" in place of the single large conductor.

Extra cost of bundle conductor for the Portland line was estimated and compared with the cost of a 345-kv series capacitor installation to accomplish the same reduction in reactance with single large conductors. The series capacitor installation would cost about four times the bundle conductor cost. Therefore, the bundle conductor design appears justified on the basis of preliminary cost estimates.

At Lewiston and Portland substations only 230-kv switching is provided, and the single 345-kv line is switched at 230-kv by including the 230/345 kv autotransformers as part of the line.

In addition to the terminals at Lewiston and Portland the 345-kv transmission line would pass near McNary power plant and the site of the proposed John Day power plant. During calculating board studies, interconnection of the 345-kv line to either or both the McNary and John Day power plants was tried to observe the effect. Although no interconnection at these plants appeared necessary, an amount has been provided in the construction cost estimate for a tie to the Bonneville Power Administration system at either McNary or John Day. Such a tie would provide operating flexibility, better distribution of line loading, and a better line outage situation.

In choosing between the McNary or John Day interconnection one factor would be the cost of the interconnection. At McNary, the present 345-kv McNary-Ross line will be switched at 230 kv, with the 245/230-kv step-up transformers switched as part of the line. To interconnect the 345-kv Lewiston-Portland line at McNary would require either the installation of two 230-kv circuit breakers and two 230/345-kv transformer banks to connect to the present 230-kv bus, or the establishment of a 345-kv bus and the installation of four 345-kv circuit breakers for the three 345-kv lines and one 345/230-kv transformer bank circuit at McNary.

To interconnect the 345-kv Lewiston-Portland line at John Day power plant would require only two 345-kv circuit breaker positions on the basis of there being a 345-kv bus. It would appear reasonable to assume a 345-kv bus at John Day as estimates show a savings of about $6,000,000 by the use of only a single step-up transformation with 345-kv switching, instead of 230-kv switching and two step-up transformations.

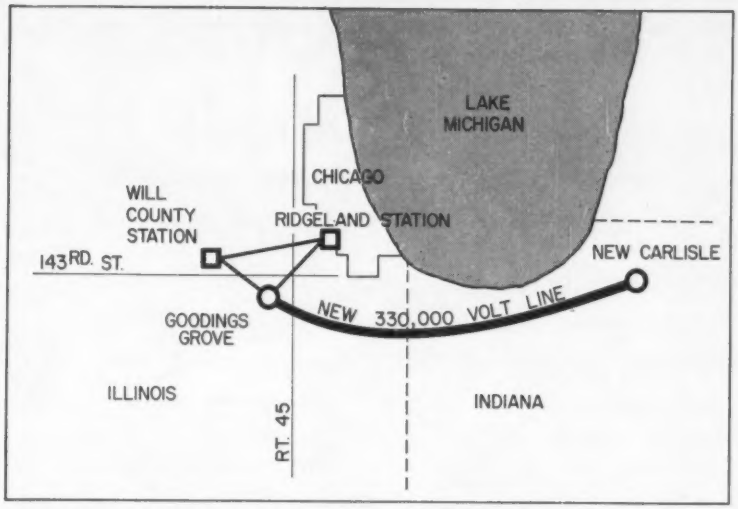
Most of the 230-kv transmission lines proposed would utilize 1,272-MCM ACSR conductor because the normal peak loads are economically high enough and because of the requirements of emergency loading.

Economic Curve Flat

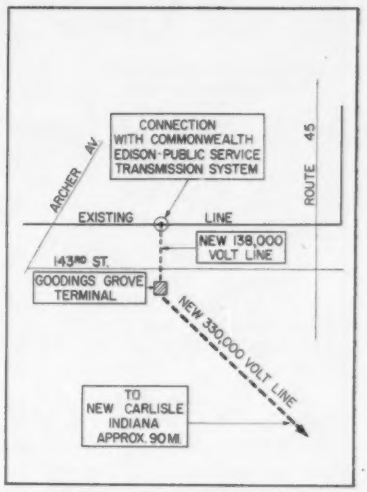
The results of an economic study of a typical line is shown in Fig 3. It is seen that the curve is quite flat and has a long range of optimum peak load power from less than 200 Mw to over 400 Mw over which the annual cost in dollars per kw per year would be near the minimum. This curve was derived by evaluating the resistance losses at $9.40 per kw per year for demand and 1.70 mills per kwhr for energy for equivalent hours of 3,250 for the year, corresponding to a loss factor of 0.37. The cost of the net kilovar transmission losses has been included in the investment, and the annual fixed charges were figured at 8% of the investment cost.

Only two conductor sizes, 795 and 1,272-MCM ACSR, were considered in the studies. Economic studies showed that 1,272-MCM ACSR was justified instead of 795-MCM ACSR where the peak load exceeded 149 Mw. It was found that where 795-MCM ACSR was proposed for economic reasons, the expected loading during emergency or summer loading conditions is also well within the current carrying capacity of the smaller conductor.

The estimated costs for the 345-kv transmission line were based upon conventional single-circuit steel towers. Investigation was made of wood-pole construction, but many difficulties of design were encounted which would make very large structures. Use of high-strength steel towers for 345 kv has some attractive features which may be worthy of closer scrutiny before final designs are completed.



NEW 90-MILE 330-KV LINE will initially transmit 300,000 kw of emergency power. Ultimate capacity of 1,000,000 kw planned. Six conductors to be 1.75 in ACSR



BIG NEW TERMINAL at Goodings Grove will tie line into Chicago 138-kv system

AG&E Linked to Chicago at 330 Kv

T. G. LECLAIR, Assistant to Vice President, Commonwealth Edison Co, Chicago, Ill.

H. P. ST. CLAIR, Manager, Planning and Operating Engineering, American Gas & Electric Service Corp., New York, N. Y.

Construction of a high-capacity extra-high voltage interconnection is planned between Commonwealth Edison Co and the American Gas & Electric System. The tie will bring substantial benefits to both companies; among them:

- Furnishing of mutual emergency and standby aid.
- Coordination of maintenance schedules of generating and transmission facilities.
- Sale and purchase of firm power.
- Sales and purchase of short-term power for the purpose of staggering generating capacity construction.

The new tie will consist of 90 miles of double-circuit 330-kv transmission line, terminating near Chicago in a switching station at Goodings Grove and in Indiana at the New Carlisle switching station of Indiana & Michigan Electric Co, a subsidiary of AG&E.

At Goodings Grove two 150-Mva auto-transformers will be installed initially, stepping down to the 138-kv transmission network at that point. Two 50-Mva synchronous condensers, operated from tertiary windings of the auto-transformers, will control reactive kva. At a later date terminal facilities undoubtedly will be increased.

At New Carlisle, a new 330-kv switching station will be built and two 150-Mva auto-transformers installed to tie in with the 138-kv system of Indiana & Michigan and, through existing interconnections, with the 138-kv system of Northern Indiana Public Service Co. As the Chicago system and its subsidiary, the Chicago District Electric Generating Corp, are also tied in closely with NIPSCO's 138-kv system through State Line generating station, the arrangements for the new interconnection was worked out in cooperation with the officials of NIPSCO.

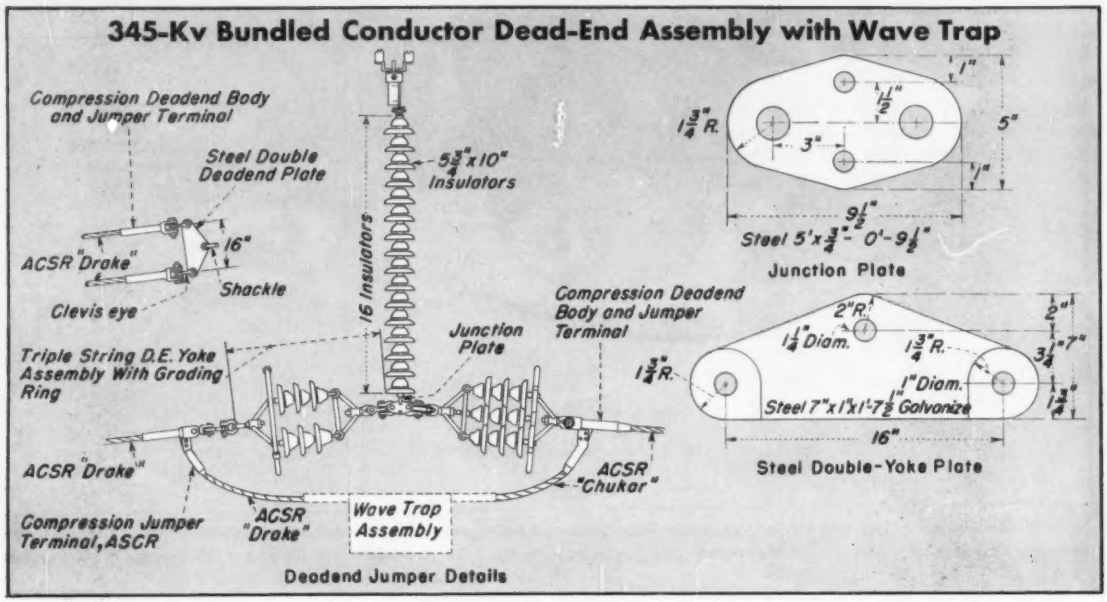
To solve the problem of excessive power flow in the paralleling NIPSCO lines, a 100-Mva ±38 deg, phase-shifting transformer will be installed at State Line between the Chicago and NIPSCO system. One of the largest of its type, this unit will be controlled automatically by telemetering impulses over communication channels from the New Carlisle station.

Estimated cost of the project, including line, terminals, and phase-shifting unit will be about $25 million.

The new double-circuit line will be of steel-tower construction with one 1.75-in., 1,414-MCM expanded ACSR conductor per phase. To prevent dancing conductors from making contact under sleet conditions, the tower will have the center conductor offset 15 ft outward from top and bottom conductors, and spans will be limited to 1,000 ft.

In addition to participating in the New Carlisle-Chicago interconnection, Indiana & Michigan is planning to build an 80-mile double-circuit 330-kv line between New Carlisle and Fort Wayne, connecting at that point with existing 332-mile, 330-kv network of the AGE system. Added to the 154 miles nearing completion and 85-miles authorized and under construction, this will bring the AG&E 330-kv system to a total of 571 line miles. Commonwealth Edison now has in operation a 150-mile 230-kv line between Powerton Station and Chicago. In view of favorable operating experience to date, consideration is now being given to changing the nominal voltage rating of both AG&E and Commonwealth Edison systems to 345 kv.

In undertaking this project, the two companies are concerned not only with the benefits to be derived from the capabilities of the interconnection as initially constructed but are also looking forward to developments in the future and the certain major growths in their respective system loads when interchange capabilities as high as 1,000 Mw may come into use through these interconnection facilities.



BPA Testing 345-Kv Bundle Design

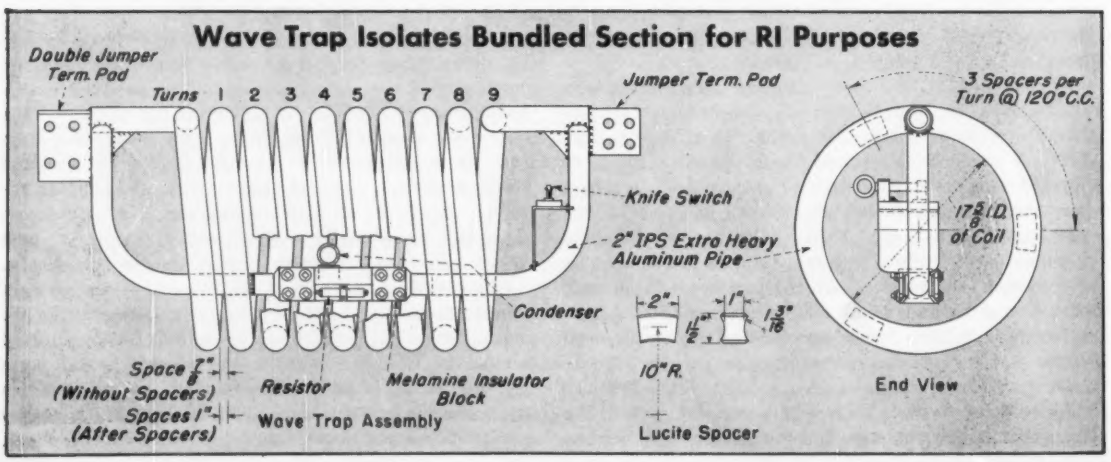
Has installed 1¼-mile section of bundle conductor in McNary-Ross line. Twin Drake conductors spaced 16 in. horizontally. Will study radio noise

Bonneville Power Administration is installing a test section of bundled conductor on its 345-kv McNary-Ross transmission line. Conductors consist of two Drake ACSR per phase spaced 16 in. horizontally. The 6,600-ft test section is located in eastern Washington five miles out of McNary substation. Remainder of the line consists of 1.6-in. diam ACSR Chukar conductor.

In order to isolate the bundled section for radio noise purposes, the two ends have radio-frequency chokes suspended from the insulator strings. A comparable section of the Chukar conductor is likewise isolated by similar chokes design details of which are shown below.

In addition to test data on comparative radio noise, several models of spacers are being installed with recording equipment to determine the effect of spacer design on conductor vibration. The models were investigated in the vibration testing laboratory at Washington State College, Pullman, Wash.

This line is scheduled for energization at 345 kv late this summer. It has operated at 230 kv since 1955.



Why Detroit Edison Picked 345 Kv

- As number of generating locations multiply and load centers increase company adopts higher transmission voltage to minimize the number of lines tying power sources and loads together

- Single generating units today are as large as largest station contemplated when company selected 120 kv as transmission voltage. Plant sizes may now reach 1,800 Mw bringing line congestion near plants

E. R. MOORE, Manager of Engineering, Detroit Edison Co, Detroit, Michigan

When 120-kv was selected some 35 years ago as Detroit Edison Co's transmission voltage, it was thought to be the ultimate voltage that would be required on this system in view of the load growth predicted. It still appears to have been a logical and economical decision. For until the present, it has served adequately and efficiently.

When 120-kv transmission was adopted, the maximum size of a power plant on a given site was not expected to exceed 300,000 kw. Total system load was only slightly over 200,000 kw, and generating capacity was approximately 300,000 kw. Initial 120 kv lines formed an outer belt tying the more remote power plants together and serving as bulk power sources, along with two centrally located generating plants, to supply the existing 24-kv cable and overhead transmission system.

Necessary rights-of-way were readily obtainable because at that time the area traversed by these lines was wholly rural. Recourse to condemnation was unnecessary. Moreover, the radio industry was still in its infancy, making radio interference of relatively minor consideration.

Foresee Plants of 1,800,000 Kw

But today conditions are different. Single generating units are now at least as large as the largest plant contemplated in 1920. Plant sizes contemplated on a single site reach 1,800,000 kw. Land that until recently has been under cultivation has become potential or actual factory, commercial or residential sites. Steel tower transmission lines have become much more numerous and, particularly in the immediate vicinity of power plants, present a congested picture.

Higher transmission voltages have come into being in Europe and in this country for a variety of reasons. There is first the need for economical transmission of sizable blocks of power from remote plants. Another basic need stems from limited rights-of-way due to geographical causes. Still another is the advisability of tying together large systems or generating or load areas for reasons of economy and reliability.

In the case of Detroit Edison Co, the primary reason for a higher transmission voltage is probably the need to minimize the number of lines tying together relatively fixed generating locations and load centers as both grow extensively in the future.

In selecting a new transmission voltage, it was desired to go to as high a level as is economically justified in order that it may again serve usefully and economically for the greatest span of years to come. After considerable study of existing systems, both here and abroad, and of the economic and other considerations, 345-kv was selected.

Design is proceeding cautiously, in order that the lines themselves may be free from radio influence, as trouble-free from lightning as possible, and economical both in the early stages and when it becomes a fully developed and utilized system.

First 345-Kv Line to be Double-Circuit

The first unit to be constructed will be of double-circuit construction and approximately 43 miles long, running from the St. Clair Power Plant to the vicinity of Pontiac, Mich. It is planned for operation initially at 120 kv and is scheduled for service in the fall of 1958, simultaneous with the in-service date of generator No. 5 at St. Clair.

Additional lines will be constructed at other parts of the system during the next several years, and these too will be operated temporarily at 120 kv.

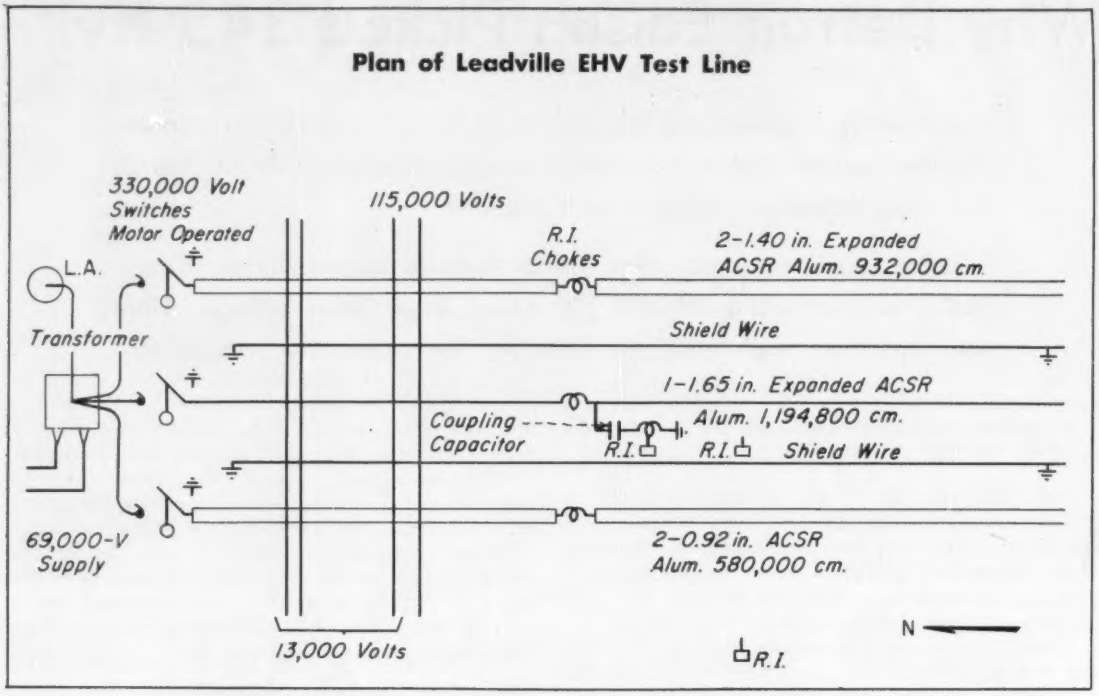
According to our present estimates of load growth and the installation of generating and transmission facilities necessitated thereby, it is believed that operation of this new system at the design voltage of 345 kv will be economically justified and, in fact, necessitated some eight years hence. The relatively high investment expense of transformers, breakers, and other similar equipment is being deferred until that time.

At the present time, attention is being concentrated on designing these facilities for satisfactory performance when the time comes to move into the higher voltage range.

Detroit Edison System Load Data

	1955	1920
Generating Capacity-Mw	2,811*	313
Max Generating Unit Rating-Mw	260*	45
System Max Load-Mw	2,463	218
Annual Output-Kw Hr x 10^6	12,726	1,002
Btu per kw hr Output	11,080	25,600
Maximum Transmission Voltage-Kv	120	24
Circ. Miles Transmission (120-kv)	1,135	0

* Designates 1956 data



Test EHV Design at High Altitudes

Research in single and bundle conductors up to 400 kv at 10,300 ft may lead to use of smaller conductors than required by present data

LAWRENCE M. ROBERTSON, Chief Electrical Engineer, Electrical Engineering Dept, Public Service Co of Colorado, Denver, Colo.

An extra-high voltage research station high in the Rocky Mountains is the bet Public Service Co of Colorado is placing to find the minimum conductor size for transmission lines at altitudes of 10,000 ft and above. The stake in this experimental "first" are substantial savings in costs of conductors and structures and an easier construction job at high altitudes.

At the experiment station now being built near Leadville, Colo., Public Service will develop basic data on corona loss and radio interference from single and bundle-conductor lines operating up to 400 kv at a reference altitude of 10,300 ft. It is hoped these data will allow the use at high altitude of a smaller conductor for EHV lines than is indicated by extrapolation of present data.

Low-altitude data from the Tidd project and information developed by the French at an altitude of 6,000 ft comprise present knowledge. Based on these data, it would be necessary to increase a 1.65-in. ACSR conductor to over 2 in. for satisfactory operation at 10,000 ft and higher. Likewise, two 0.94-in. bundled conductors would go to 1.4-in. at 16-in. spacing.

Study Spacer Bar Design

In the field of design of spacer bars for EHV bundled conductors, there is limited operating experience. Based on test experience compiled by one of the manufacturers cooperating with Public Service at Leadville, there is no clear-cut answer to this problem. Associated with bundled conductor is the question of horizontal vs vertical spacing. Either has its individual problems, and neither is the better solution. At Leadville, tests of spacer bars may point to advantages of one configuration over the other.

Need for data and operating experience is a pressing one for the Colorado utility. Its present 115-kv transmission system is not designed to carry the loads represented by proposed developments in the Rocky Mountain area. The company must prepare now for system growth which will demand more power in service areas west of Denver and across the Continental Divide. These factors point to transmission at something higher than 115 kv through mountain passes and reaching about 260 miles. Extra-high voltage under these conditions could provide for load transfer, system stability, and delivery of power at the most economical cost.

Data from the Leadville tests also will find application throughout the world. In both hemispheres there are projects remote from load centers and separated from them by high mountains that could prove feasible if lower-cost high and EHV lines were possible.

The Leadville station will consist

500-KV TEST TRANSFORMER on last leg of trip to experiment station. Supplied at 69 kv, the single phase unit will provide an equivalent line-to-line potential that can be adjusted from 264.5 to 500 kv for experimental purposes

of a substation, switching facilities, and about 7,000 ft of 3-phase EHV line. The main transformer will include a 1,667-kva single-phase unit fed from a 69-kv line and providing an equivalent line-to-line potential adjustable from 264.5 kv to 500 kv. Unit will be connected solidly-grounded on one side of the high voltage winding.

Test Bundle and Single Conductors

The first phase of the transmission line will have two 0.92-in. ACSR conductors in a flat configuration. The middle phase will be a single conductor of 1.65-in. expanded ACSR. These two phases are of the same size and arrangement as those tested at the Tidd project and will provide a direct comparison with low-altitude data. The third phase will be two 1.4-in. conductors spaced 16 in. apart horizontally. This conductor and arrangement are those indicated as necessary by present formulas.

Overhead static wires will be 159 MCM ACSR. One 102-ft steel tower and one tubular steel H-frame are being provided. Remaining structures will be wood H-frames, some of which will have timbers and others wood spars for arms. There will be one long span of 2,130 ft which will attain a maximum altitude of 10,540 ft. The remaining length of the test line will consist of nine spans averaging 767 ft in length. Thus, data will cover both long and "normal" span performance under varying wind and weather conditions.

Instrumentation is being installed to collect these electrical data—line voltage, line charging current, corona loss, radio interference directly under the line and at right angles 200 ft from the line, and radio interference from the line through coupling capacitors and a NEMA circuit. Lightning stroke crest current measurements will be made with magnetic links.

To relate electrical data with weather conditions, these factors will be recorded—ambient temperature, barometric pressure, relative humidity, dew point, wind direction and velocity, instantaneous rate of precipitation, and photographic records of precipitation (rain, snow, fog). Much of the data will be recorded simultaneously on one chart to avoid misinterpretation of results due to discrepancies in time. Tests and observations of mechanical properties of wood and steel structures through extremes of weather will be made.

While completion of the Leadville station is slated for this summer, tests will not start until late summer. It is hoped that definite results will be available after about two years of operation and testing. Weathering of the conductor is one factor that will require a significant period of time.

Manufacturers Taking Part

Manufacturers participating in the Leadville tests and providing material are Westinghouse Electric Corp—transformer, lightning arrester, 330-kv motor-operating gang switches, and instruments; Ohio Brass—insulators and hardware; Alcoa—conductors and accessories; American Bridge Co—102-ft steel tower and tubular steel H-frame; Hughes Brothers Co—timber arms, braces, and fittings; Malleable Iron Fitting Co—wood-spar-arm hardware. Public Service is building the substation and transmission line, will provide all poles and spar arms, and will collect data and assist in preparing reports.

230-Kv Pipe Cable Is First in U.S.

Army Engineers have interconnected transformer banks for three units at Garrison Dam with switchyard 1,000 ft distant. Cable is in tunnel

Circuit Data and Cable Rating

1. Voltage between phases, kv	230
2. Number of phases	3
3. Frequency, cps	60
4. Continuous current-carrying capacity of cables, amp	250
5. Maximum ambient air temperature, F	45
6. Nominal oil pressure in pipe, psi	200
7. Maximum conductor copper temperature, F	65
8. Cable size, MCM	500
9. Number of conductors per phase	1
10. Nominal conductor insulation thickness, mils	835
11. Average circuit length, ft	1,000
12. Nominal minimum outside diameter of steel cable pipe, in.	8⅝
13. Wall thickness of pipe, in.	¼
14. Nominal inside diameter of copper tubing used from trifurcating joints to 230-kv terminations, in.	4
15. Wall thickness of tubing, in.	0.134
16. Bushing dielectric characteristics:	
60-cps withstand (dry), kv	545
60-cps withstand (wet), kv	445
Impulse withstand, kv	1,050
17. Pumping Plant	Dual type with duplicate pumping units

W. K. CAVE, Corps of Engineers, U. S. Army

The 230-kv, pipe-type cable at the Army Corps of Engineers' Garrison Project, Mercer County, N. D., is the first such cable installation in the United States. It has been in operation since January when the first 80,000 kw was delivered on a commercial basis.

This 230-kv oil-filled, pipe-type cable system interconnects the main transformer banks for generating units Nos. 1, 2, and 3 with a 230-kv switchyard approximately 1,000 ft distant.

Cables Are in Tunnel

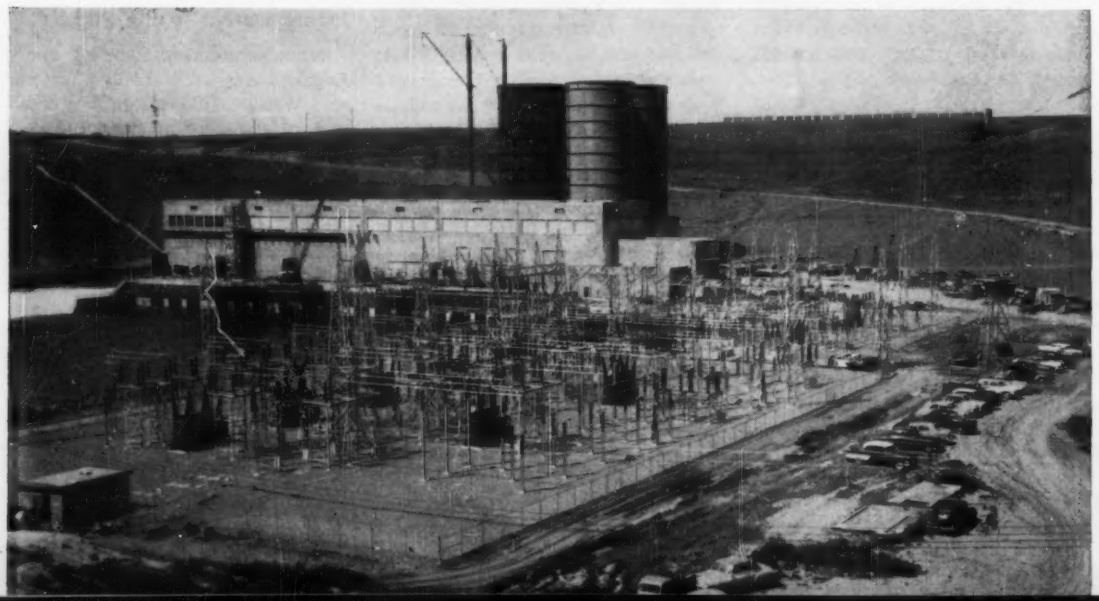
The cables are in a tunnel extending the length of the powerhouse beneath the transformer deck and underground beneath the centerline of the switchyard for its full length. The tunnel is 7 ft wide and 8 ft high, except the 16-ft-high part within the powerhouse structure. The tunnel has forced ventilation, but is not artificially cooled.

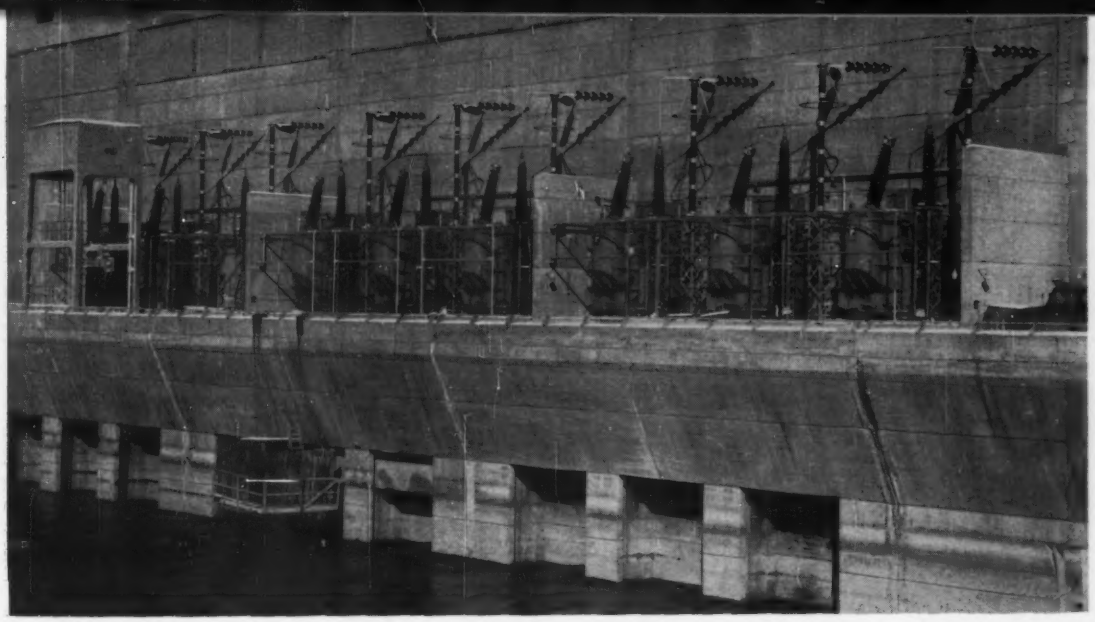
Each main transformer bank has three single-phase, 33,333-kva transformers of the outdoor, oil-immersed, forced-oil-cooled type which stepup voltage from 13.2 kv delta to 230 kv grounded wye. These are on a deck along the downstream side of the powerhouse. This placement saved an estimated $750,000 or more, compared with location in the switchyard. The difference in cost of generator leads, tunnel, and transformers was, primarily, the area of savings.

Why Cables Went Underground

The decision to use underground connections between the transformers on the powerhouse deck and the switchyard was based on these reasons:

GARRISON POWER HOUSE, together with the switchyard is shown in this downstream view of the Corps of Engineers' project in North Dakota. Underground oil-filled cable connects the transformer banks with switchyard in foreground





TRANSFORMER BANKS were installed on deck on downstream side of the powerhouse. Photo shows single-phase 33,333-kva units in groups of three and the 230-kv oil pipe cable terminations. Cable makes connection with switchyard

1. Elimination of interference with transmission lines crossing the tailrace.
2. More flexibility in the event of changes in the switchyard.
3. Conductors are not exposed to ice and wind difficulties caused by freezing spray from the outlet work and tailrace.
4. Lower maintenance cost.
5. Improved appearance of powerhouse and switchyard.

These advantages, it was found, could be secured at a comparable cost. Use of oil-filled pipe cable was decided on only after an extensive study of the several types of cables that were or could be made available for the intended service.

Plan Two 115-Kv Circuits

Although only three pipe cable circuits are now installed, the pumping unit and the tunnel layout were designed to accommodate two future 115-kv circuits for generator units 4 and 5. Pipe cables are supported along the tunnel walls. Main pipes, containing the three conductors of a circuit, terminate in trifurcating semi-stop joint assemblies.

Beyond these joint assemblies, each conductor is housed in a separate non-magnetic pipe extending through the roof of the tunnel to a 230-kv, 200-psi oil-pressure cable terminal. These terminals are supported on structural steel pedestals. Each circuit has three single-conductor, 500-MCM, crushed-oval, compression-type cables in an oil-filled pipe. Major and minor axes of the crushed-oval conductor are 0.90 and 0.60 in., each.

Metalized paper tape strand shielding is wound over the conductor. Over this is an impregnated paper insulation. Combined thickness of strand shielding and impregnated paper is 0.835 in.

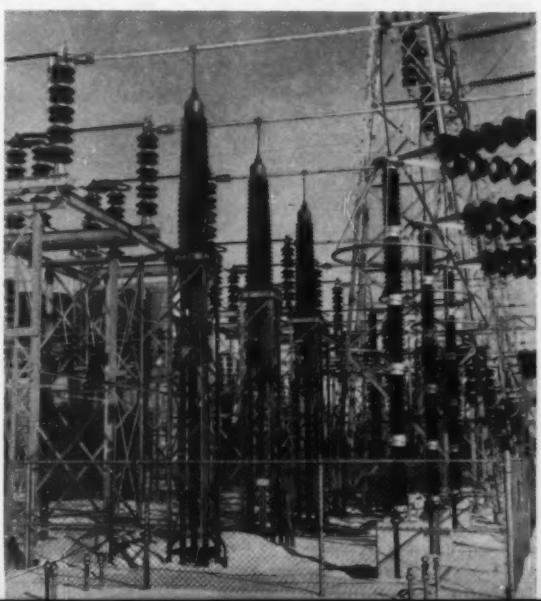
The insulation is covered with perforated copper shielding tape 0.003 in. thick, intercalated with paper tape. Over this are two paper tapes of 0.005 in. thickness, a polyethylene sheath 0.060 in. thick, reinforced with one 0.005-in. bronze tape ⅛ in. lapped, intercalated with 0.008-in. polyethylene tape, and two "D" shaped brass (70/30) skid wires $\frac{1}{16}$ by $\frac{3}{16}$ in. annealed, with an 8-in. lay.

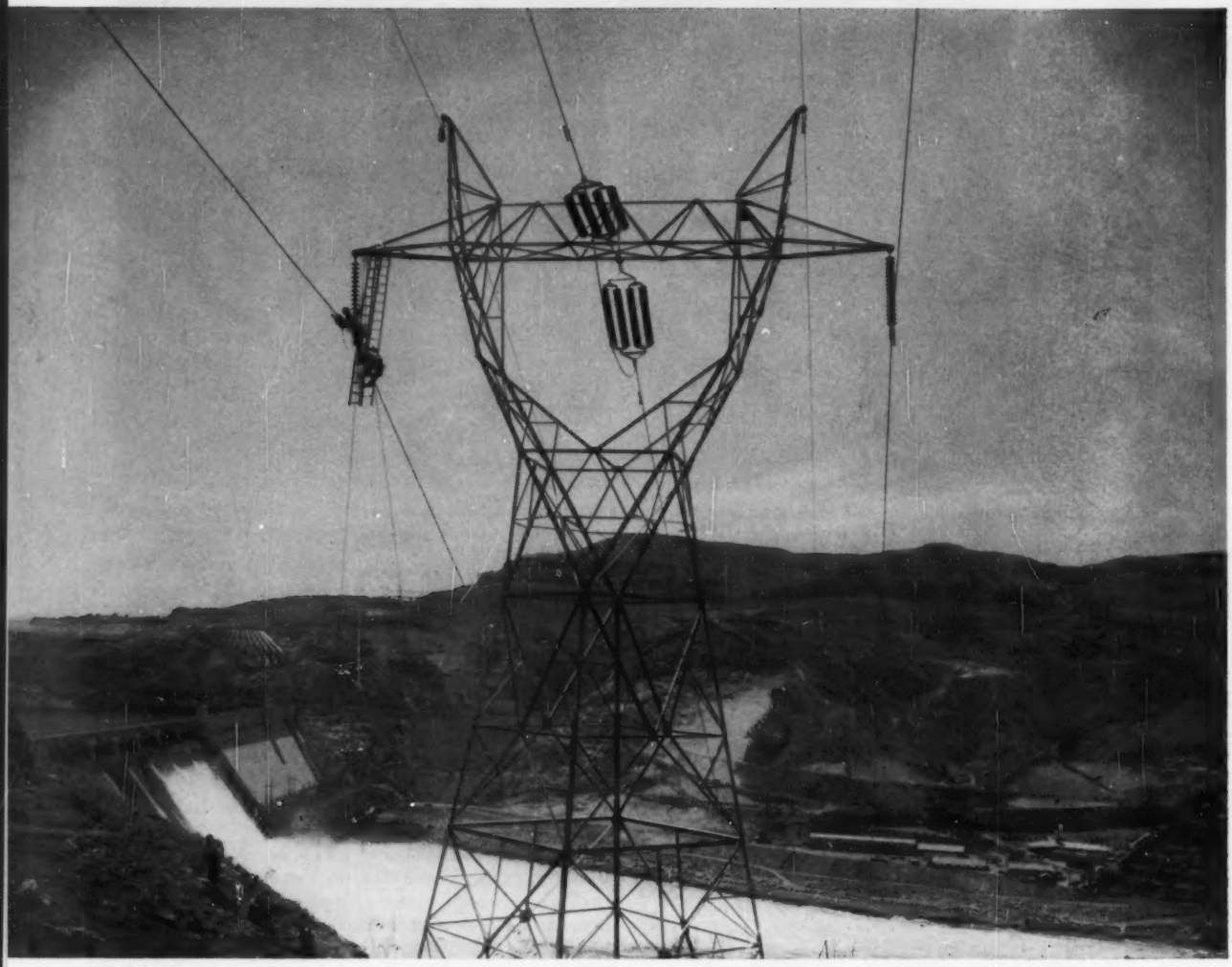
The major and minor axes of the finished cables are about 2.96 and 2.66 in. respectively.

Garrison Dam and Reservoir Project, key unit in the control and development of water resources of the Missouri River Basin, has three initially installed power units with a capacity of 240,000 kw. Three units are operating; the third is scheduled for operation this month. Ultimate capacity will be 400,000 kv in five units. The power plant is on the Missouri, 75 miles northwest of Bismarck and three miles west of Riverdale, N. D.

The initially installed units are connected to the 230-kv switchyard which will be tied, through a 100,000-kva autotransformer bank, to the 115-kv switchyard. Two future units will be connected to the 115-kv switchyard next to the powerhouse. Switchyards are parallel to the tailrace and at approximately right angle to the outgoing lines.

GARRISON SWITCHYARD where 230-kv oil pipe cable is brought through joint assemblies to terminals





CENTER PHASE IS deadended to raise conductor and give clearance to tower body because of steep angle of conductor dropping down hill toward Grand Coulee switchyard. The two outer conductors are hung on suspension insulators

Early Experience Proves EHV Design

BPA learns that 287-kv line design based on extrapolated 230-kv experience is sound. Extension to 345 kv will be next program step

RICHARD F. STEVENS, Chief of Design, U. S. Dept of Interior, Bonneville Power Administration, Portland, Ore.

The validity of designing extra high voltage lines by extrapolation of operating experience with 230-kv lines has been successfully demonstrated by the experience and tests on the first 287-kv circuits of the Bonneville Power Administration. Similar verification of 345 kv design is expected.

No unusual problems have been encountered at the higher voltages, except for occasional difficulties resulting from high magnetizing inrush currents. These have required special attention to relay settings in order to prevent relay operation upon line energization.

Extrapolated data have been used in tower design, insulator requirements, and choice of conductors as regards radio interference. Results have shown that:

1. Towers have been structurally adequate.

2. Outages have been within acceptable limits, and insulators have provided sufficient mechanical strength.

3. Successful operation is possible if the conductor is erected in good condition and "seasoned."

Operating experience with extra high voltage began in the summer of 1955 when the line from Grand Coulee to Olympia was raised from 230 to 295 kv. In the fall of the same year this voltage was raised to 307 kv, and the line has since been in successful operation. This is the first of many BPA lines which will eventually be operated at extra high voltages.

Originally, all main grid lines were designed for 230 kv. About eight years ago, however, the transmission distances and future loadings of some of the new lines being planned were found to be such that ultimate operation at a higher voltage should be considered.

230 Kv Insulation Used for 287 Kv

Insulation and clearances then in use at 230 kv were based on the more conservative practices once common in the industry and were found to be adequate for 287 kv. It was, however, necessary to increase the conductor size. Economic studies indicated that savings in losses on the circuits where the larger conductor was applied would be large enough with the loadings obtained even at 230 kv operation to justify the extra conductor cost.

Including the Coulee-Olympia line, 12 of these lines have been built or are under construction, totaling 1,438 circuit miles. Experience on the Coulee-Olympia line indicates that it should be possible to operate these lines at actual voltages somewhat above 300 kv.

Three Circuits Designed for 345 Kv

A few years ago, system studies indicated the desirability of selecting an even higher voltage for certain lines. Accordingly, the following three trunk circuits, designed for 345 kv, have been built or are under construction:

McNary-Ross 175 miles.

Chief Joseph-Snohomish 133 miles.

Chief Joseph-Covington 165 miles.

The two sections of the McNary-Ross line were placed in service at 230 kv in April and October 1955 respectively. The voltage is scheduled to be raised to 345 kv in the fall of 1956. The Chief Joseph-Snohomish line was put in service at 230 kv in March 1956. Date of operation at 345 kv has not been definitely scheduled. The Chief Joseph-Covington line is scheduled to be energized at 345 kv in the late summer or fall of 1957.

As in the case with the 287-kv lines, extrapolated data was used to design these lines. A comparable verification of the 345-kv design must await installation of autotransformers this fall to convert the McNary-Ross line to the higher voltage.

345 Kv Towers Similar to 230 Kv

BPA steel tower circuits, regardless of voltage, make use of "standard" (single or double circuit) and "light steel" designs (single circuit only). Choice between standard and light steel single circuit towers is based on the mechanical loadings on the section of line in question. Standard designs predominate in rugged areas and where severe icing conditions are encountered.

The 230-kv standard designs, whether for tangent, angle, or dead-end towers, are the conventional self-supporting, rotated type. The 287 and 345-kv standard towers are very similar to these, except for appropriate increases in clearance and strength to handle the higher voltages and mechanical loadings.

The light steel tangent towers for all three voltages are likewise similar in appearance. They differ from their standard counterparts in that they are not designed to withstand the full unbalanced force resulting from a broken conductor. Hence they can be made somewhat lighter in design.

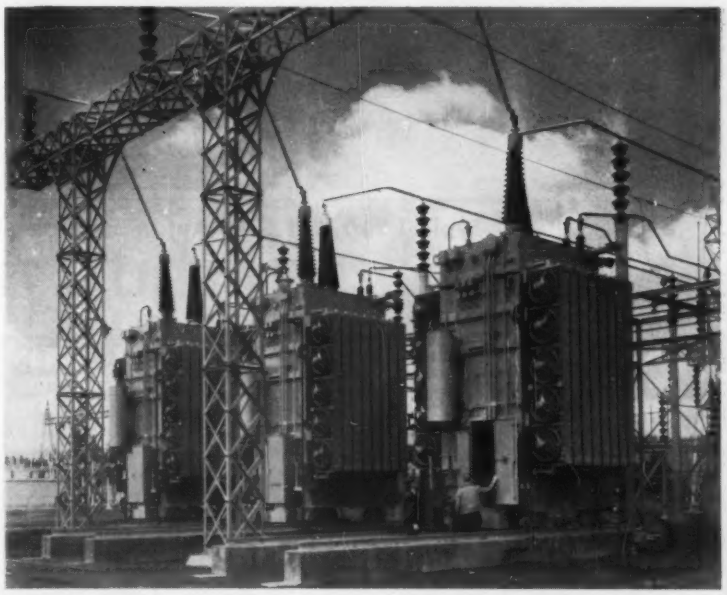
The light steel 230 or 287-kv heavy-angle or dead-end is made of three lattice columns, heavily guyed. This design is not used for 345 kv.

As previously indicated extrapolation of previous data has been helpful in tower design, although rather complete design tests on prototype structures have been made for each voltage class.

500 MCM Cu equivalent ACSR (Drake) conductor was normally used on early 230-kv lines and on some recent lines where great increases in loading are not expected. 800 MCM Cu equivalent ACSR (Pheasant) conductor has been used during the last eight years for 230-kv lines which will be heavily loaded; especially if there is a likelihood of operating them at 287 kv nominal voltage. 1,120 MCM Cu equivalent ACSR (Chukar) conductor has been used for lines designed for operation at 345 kv.

RI Tests on Conductors

Choice of the Pheasant and the Chukar conductors for their respective voltages was based on comparative tests in the Oregon State College high voltage laboratory. These tests indicated that it would be possible to limit the radio noise, at the corresponding higher voltages, to values reasonably comparable to those found



AUTOTRANSFORMERS rated 230/295 kv with 5% taps on each winding, provide 241.5 and 307 kv. Transformers have a capacity of 240 Mva self-cooled and 320/400 Mva forced cooled

at 230 kv, providing care was taken to avoid roughening of the conductor during stringing.

Extreme care is necessary with Chukar and Pheasant conductors so as to avoid abrasion. Some contractors have kept the conductor from contact with the ground by stringing under tension; others by complete lagging throughout. In the earlier stages of stringing on the first 345-kv line, trouble was encountered with individual strands "popping out" as they left the reel or passed over the tension drum or stringing sheaves. These protrusions are potential corona and radio noise sources. This tendency has since been successfully corrected.

The minimum numbers of insulator units in suspension strings on 230 kv, 287 kv, and 345-kv lines are 12, 16, and 19 respectively. Two additional units are added in dead-end strings.

Insulator Arrangements

Insulators used for 230 and 287-kv circuits are standard 15,000-lb units, and those for 345-kv circuits are standard 25,000-lb high-strength units. Triple strings of 15,000-lb insulators are used in deadending Drake conductor, four strings of 15,000-lb insulators for Pheasant, and triple strings of 25,000-lb units for the Chukar Conductor.

Grading rings are not used for either 230 or 287 kv but are installed at the conductor end of the 345-kv strings.

There has been no occasion yet to interconnect or switch any circuits above 230 kv. Instead, each line with its autotransformers at the two terminals will be relayed and switched as a unit, using the breakers on the 230-kv sides. Moreover, in case of an autotransformer failure at either end, disconnecting switches are provided to bypass both autotransformer banks. The line may then be operated at 230 kv.

The autotransformer banks at the ends of the Coulee-Olympia line have basic insulation levels of 1,050 and 825 kv, on the HV and LV windings, respectively. They are rated 230/295 kv, 240/320/400 Mva. Taps are provided on LV and HV windings to give 241.5 and 307 kv, respectively, if desired. For the 307-kv operation the transformers at the Grand Coulee end are set on the 241.5 and 307-kv taps as the Grand Coulee voltage is normally about 241 kv. At the Olympia end the taps are set for 307 and 230 kv as the latter is the present normal bus voltage that exists at this point on the system.

Transformer BIL Levels

The autotransformers ordered for the McNary-Ross and Chief Joseph-Covington lines have basic insulation levels of 1,175 and 825 kv. They are rated 230/345 kv, 360/480/600 Mva. Taps are provided on the LV and HV windings for 241.5 and 319.1 kv, respectively. The latter is a reduced capacity tap which would be used only if radio interference difficulties, not now anticipated, were to be encountered.

Radio interference noise tests were made on the Grand Coulee-Olympia line in April 1956. The purpose was twofold:

1. To determine the feasibility of operating the line above 307 kv.

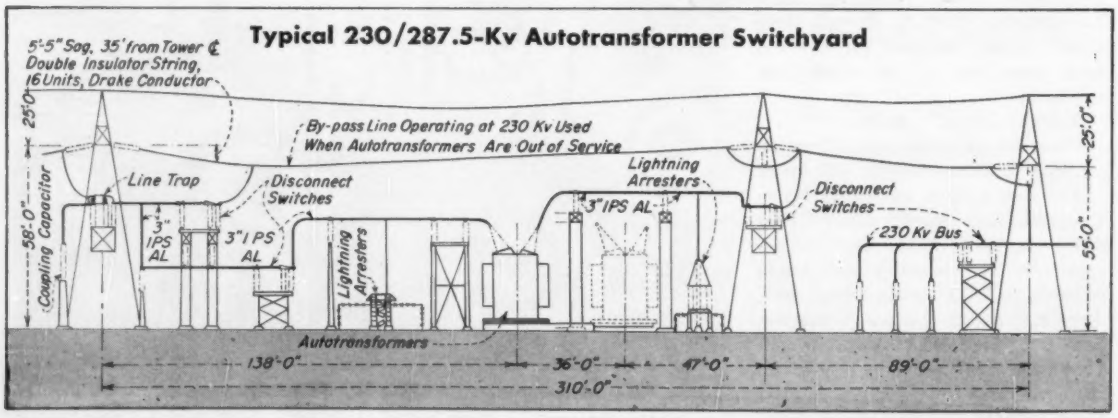
2. To obtain correlation between laboratory and field data to help predict field performance of the 345-kv Chukar conductor lines.

The line was isolated from the system and energized from two generators at the Grand Coulee power house end, with the Olympia end open. With the aid of the Ferranti effect it was possible to get voltages as high as 410 kv at one test site (single circuit towers—horizontal configuration) and 380 kv at the other site (double circuit towers—vertical configuration) with a single circuit strung. Weather was fair and sunny during the test.

Test readings were taken at voltages of from 234 kv to 410 kv. These indicate that for an effective operating voltage of 322-kv RI noise levels would be less than 15 mv per meter at 200 ft from the line on the single circuit section, and only about 20 mv per meter at the same distance from the double circuit section. The double circuit section is, mainly, in a sparsely settled mountain area.

Performance Encouraging

If this performance is maintained, it would suggest the possibility that Pheasant conductor, erected in good condition and "seasoned," might be operated successfully at voltages appreciably higher than 300 kv. Considered in connection with comparative laboratory tests on various conductors, it also provides reassurance on radio noise levels to be expected when the Chukar lines are raised to their rated operating voltage of 345 kv.



SWITCHING IS PERFORMED on 230-kv side, no switching has been done on BPA lines above 230-kv. Autotransformer installations are so designed that they may be bypassed at both ends of the circuit to permit operation at 230 kv

Indianapolis Power & Light meets area's growth with 100,000 kw addition to White River station

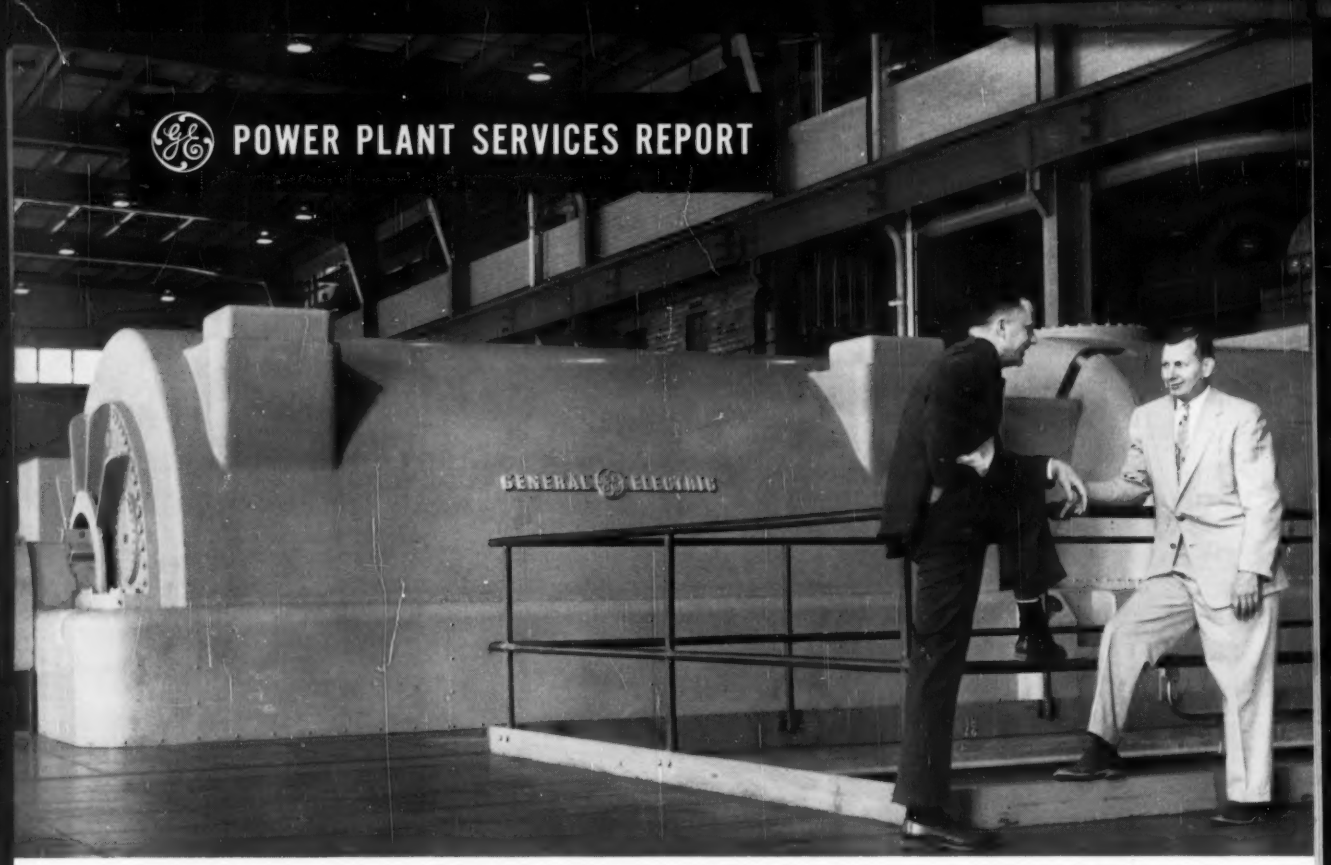
The enormous postwar industrial and residential boom in and around Indianapolis—load has soared to well over twice 1945's figure—meant this: Indianapolis Power & Light had to act fast to keep ahead of its customers' growing demands for electricity.

And act fast it did. More than $100,000,000 have been invested in system expansion since 1947—twice the amount spent during the previous 20 years. The high point of this growth is the White River station.

In expanding this plant by installation of a 100,000-kw G-E turbine-generator, IP&L is stepping up total system capacity about 20%. By specifying "General Electric," the utility and its consultants, Gibbs & Hill, Inc., were able to capitalize on General Electric power plant services . . . saving time, money and manpower.

FOR MORE DATA TURN PAGE ▶

GENERAL ELECTRIC



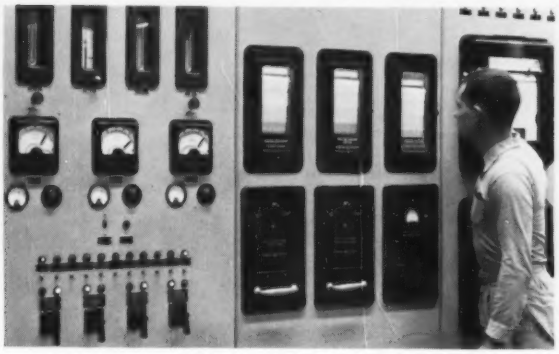
ADVANCE PLANNING, coupled with well-integrated plant and equipment design, helped Indianapolis Power & Light to achieve on-time start-up of new General Electric 100,000-kw turbine-generator at the White River station, latest addition to system.

I.P.&L.'s sixth G-E unit at White River

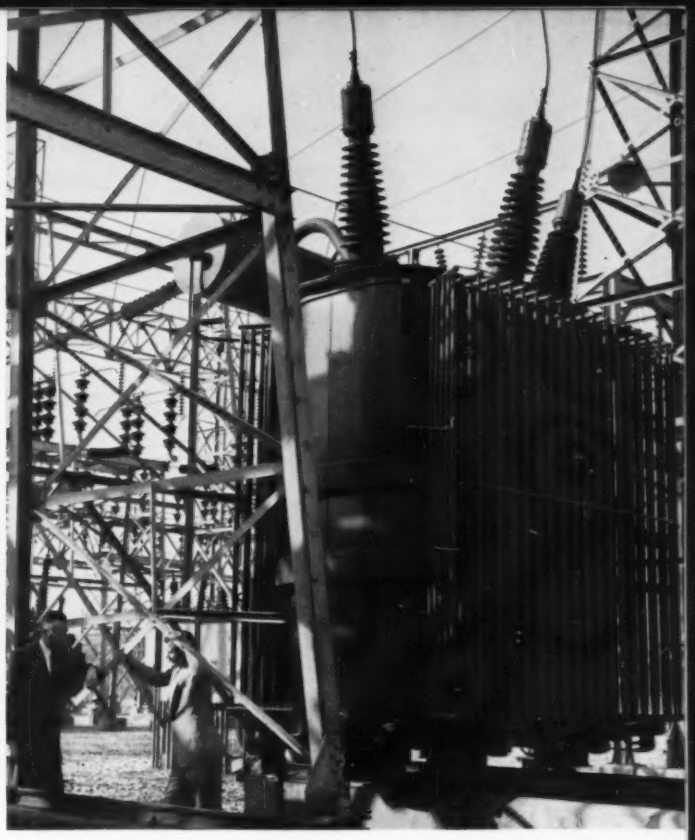
REVIEW of proposed expansion of the White River station is made by D. C. Hess, V. P., Engineering and Construction; J. D. Blythe, Administrative Asst.; H. T. Pritchard, Pres.; all of IP&L, as John Calder, G-E sales engineer, looks on.

STATION'S IMPORTANT PHASES got full attention of E. L. Champion, Gibbs & Hill, Inc. V.P.; IP&L's Pritchard; D. B. Sloan, Gibbs & Hill, Inc., Pres.; and IP&L's D. C. Hess; G-E engineers freed utility, consultant of many details.

INTEGRATED DESIGN of General Electric metal-clad switchgear with other apparatus was assured by G-E application engineers to help give the White River station the advantages of top operating flexibility.



PROPER SELECTION of General Electric turbine-supervisory instruments is paying off for Indianapolis Power & Light in terms of more efficient operation and prolonged life of power generating equipment.



ON-TIME DELIVERY of equipment like the 3750-kva General Electric auxiliary power transformer shown here, assured by General Electric power station services, helped speed power plant construction, and helped reduce installation costs.

fills out co-ordinated expansion program

G-E teamwork with IP&L and Gibbs & Hill, Inc. engineers, assures integrated equipment designs, saves engineering time on White River plant expansion

Sound planning for the future has first priority in Indianapolis Power & Light's expansion program. For example, at the White River station where IP&L had previously installed five G-E turbine-generators, a sixth 100,000-kw unit was recently added to meet expanding load requirements. Each of these units has been carefully co-ordinated with associated electrical equipment in design and operation to assure maximum flexibility and effectiveness in plant operation.

G-E engineers, working with the utility and their consultants, Gibbs & Hill, Inc., co-ordinated the design and construction of the new apparatus to meet more exactly the station's operating requirements.

Such application engineering on new equipment is just one of many G-E power plant services on your job when you or your consultant order G-E apparatus. Product development engineering, field service engineering, and project co-ordination also help to:

Simplify ordering of equipment purchased either directly or through your consulting engineers, or through a machinery manufacturer.

Conserve engineering time by assisting with electrical equipment details, thereby freeing you and your consulting engineers for other urgent problems.

Integrate equipment design with consultant's plant design to assure the maximum flexibility and effectiveness of operation.

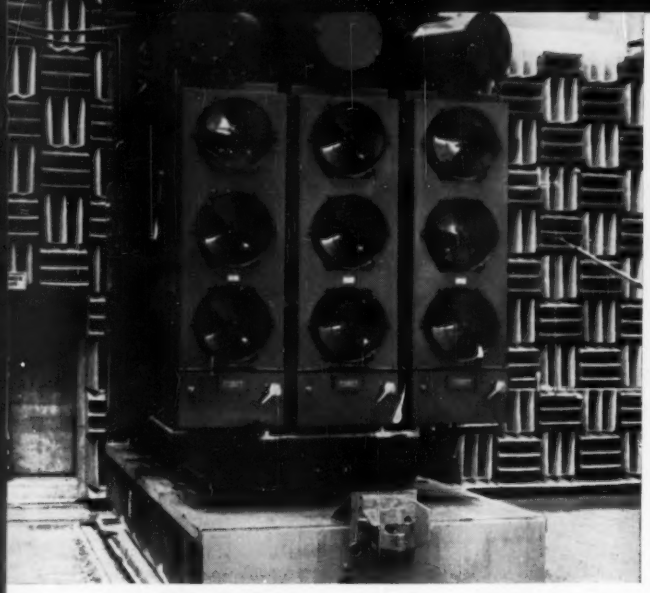
Speed construction by scheduling the arrival and disposition of equipment for maximum installation efficiency and on-time start-up.

Assist in training operators to better understand the full operating capabilities of the equipment.

For details, contact your General Electric Apparatus Sales Representative. General Electric Company, Schenectady 5, N. Y. 302-16

GENERAL ELECTRIC

POWER PLANT SERVICES REPORT



FULL-TIME OPERATION of General Electric's Sound Laboratory is helping engineers solve transformer noise problems. Ideal, separate testing area permits accurate measurement of even the slightest gain in sound level reduction.

NEW AIR BLAST POWER CIRCUIT BREAKER forecasts a complete line of such General Electric breakers through 330-kv to help utilities to reduce maintenance costs, and to eliminate scheduled oil filtration and refilling requirements.

Latest G-E product developments point to new advances in cutting system operating costs

Development of a modern air-blast power circuit breaker which promises maintenance savings, and full-time operation of General Electric's multi-million dollar Sound Laboratory—these are just two of many recent events at General Electric that serve to spotlight the technological advances being made every day to improve steam turbine-generators, switchgear, transformers, motors, controls, instruments and other electrical apparatus needed in power stations. And they signify General Electric's continuing program to provide electric utilities with a positive answer to overcome constantly rising system costs.

RECORD EXPANSION INVESTMENT

How far will this program go? The answer is dramatically illustrated by the fact that General Electric's record $175 million investment earmarked for expansion of laboratory and manufacturing facilities during 1956 is well on the road to fulfillment.

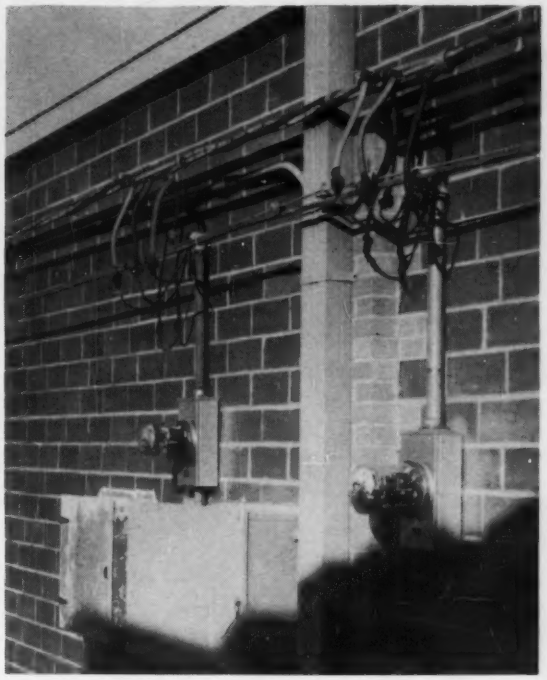
TEAMWORK IN PLANNING STAGES

As the trends in power station equipment continue to require higher ratings, improved efficiencies, and to maintain reliability, the advantage of selecting General Electric apparatus, compounded with the time-saving, money-saving benefits of G-E engineering teamwork, offers electric utilities a striking example of why it pays to call in G.E. early in your planning. 302-16

MORE POWER TO AMERICA

GENERAL ELECTRIC

METERS ARE SPACED to meet store needs when services tap open-wire secondaries installed along the building wall



MULTIPLEX SECONDARIES installed along building wall are easily tapped whenever it is necessary to serve stores

Individual Metering Is Favored

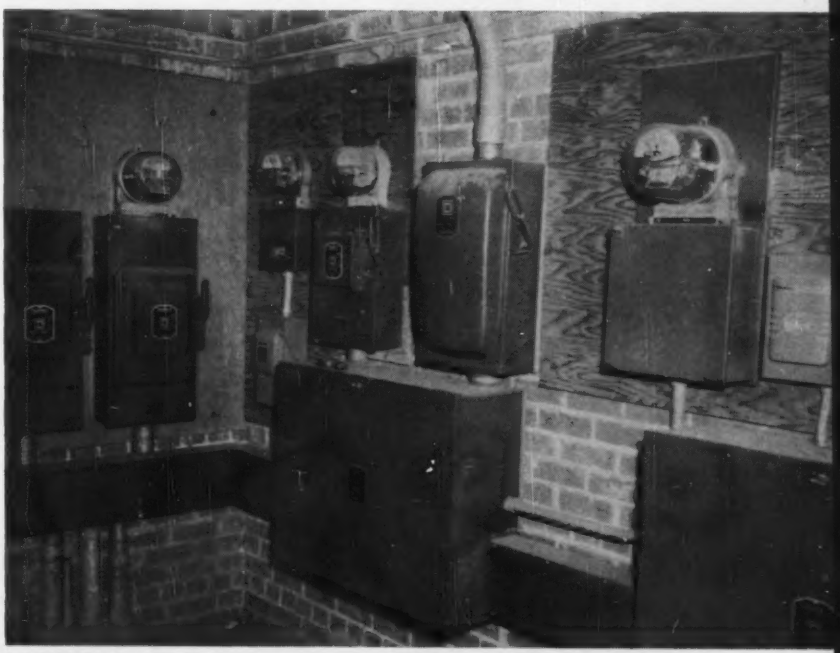
METERING—Design

An Electrical World survey of shopping center distribution practices showed that 107 centers, or 86.5%, have individual customer metering and 12 centers both individual and master metering. Installations were made in the following ways:

1. In groups, with meter rooms adjacent to transformer vaults or to where overhead services enter.
2. On outside walls of buildings where customers tap open wire secondaries installed on brackets on building walls.
3. On building walls where multiplex secondaries are installed along the wall.
4. On building walls where multiplex or open wire services are run in the conventional manner.

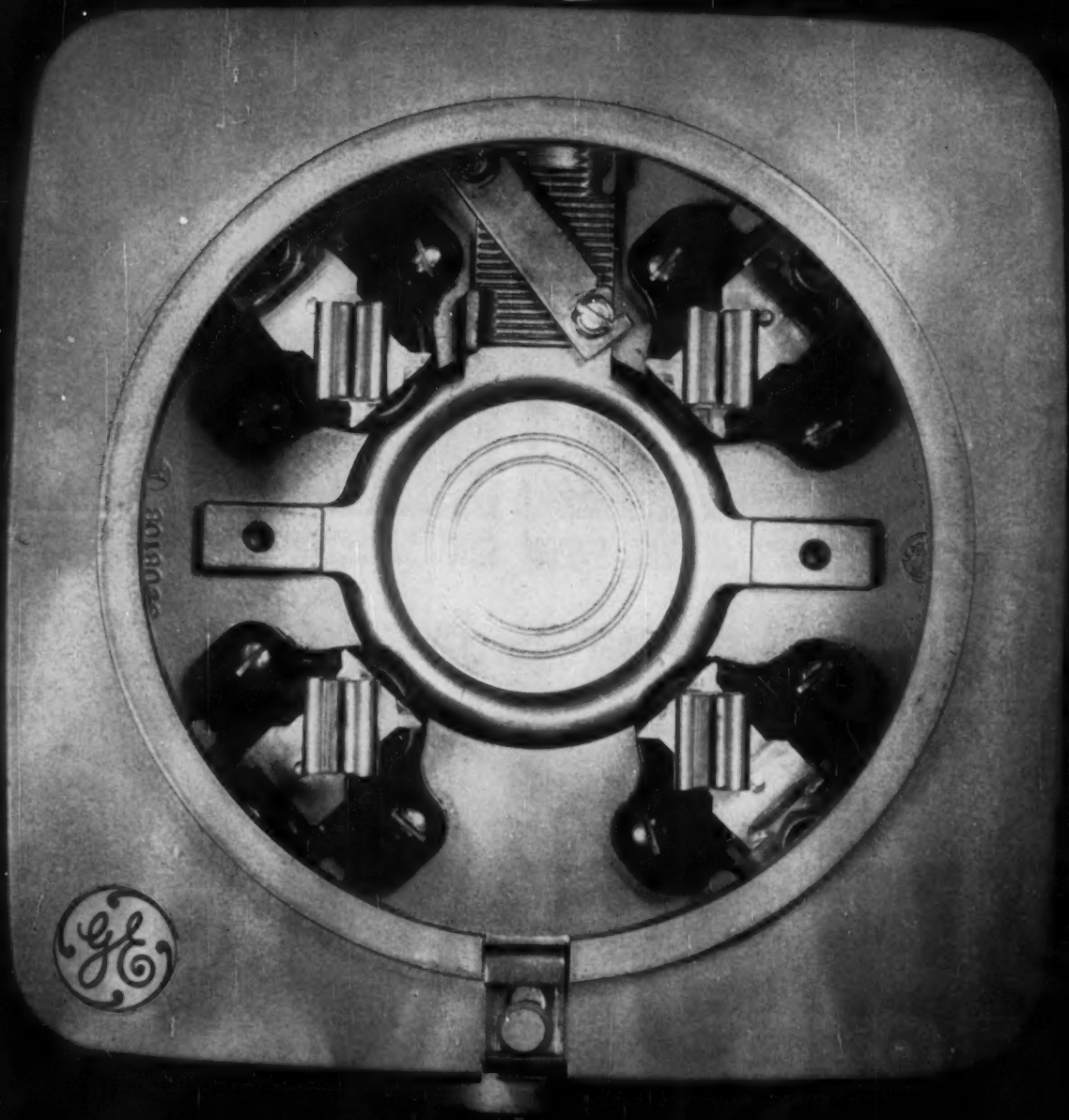
Master meters are installed for the complete shopping center in only five cases. These centers submeter service to individual stores, a practice usually frowned on by utilities.

(*More How To on page* 107)



METER ROOMS are frequently adjacent to transformer vaults, as in this case, or to ground-type transformer installations with secondary piercing the wall

NEW G-E Square Meter Socket



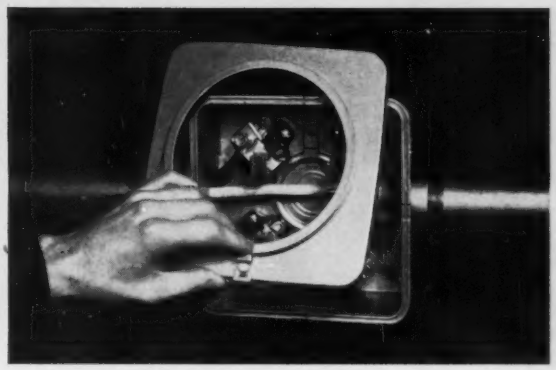
Progress Is Our Most Important Product

GENERAL ELECTRIC

for Installations Up to 100 Amps

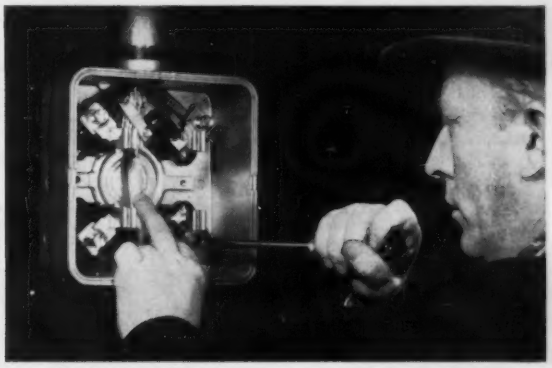
offers you these important, money-saving benefits

1. POSITIVE, ONE-WAY KNOCKOUTS—New pre-scoring arrangement on both inside and outside of socket assures perfect knockout every time. No prying or bending needed.

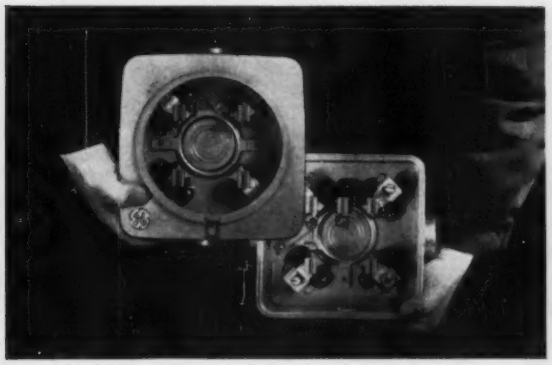


2. EASIER ACCESS—Unique snap-lock cover can be removed and replaced in seconds without any tools. Just flick the lock, lift the cover and socket is open and ready for wiring.

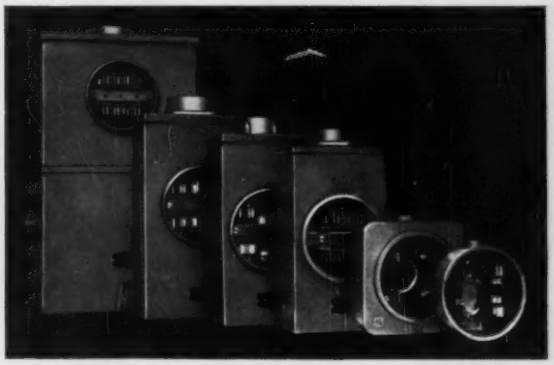
3. 100-AMP CAPACITY—Assures that today's installation will meet greater loads of future. New socket is perfect partner for General Electric's I-55 extended range meters.



4. EASIER, FASTER WIRING—a unique, modern design, plus lay-in type terminals requiring wiring bend of only 45 degrees speeds up and simplifies installation.



5. GREATER VERSATILITY—New G-E square meter socket can be mounted vertically or horizontally. Added flexibility is obtained by easy addition of fifth or sixth terminal.

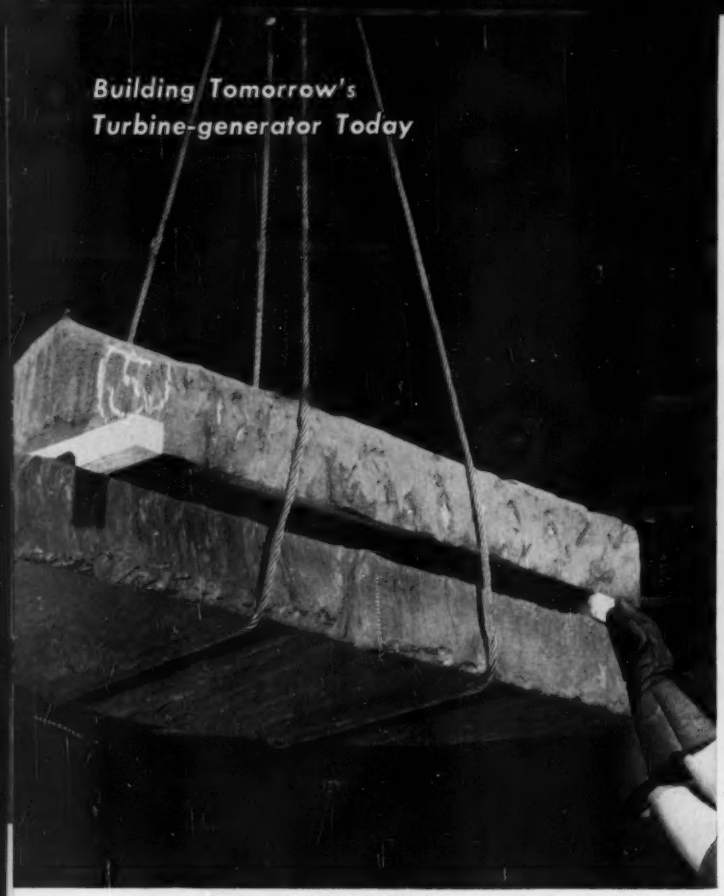


6. A COMPLETE LINE—CT sockets, high-capacity, box-type, and round and square sockets for single-phase meters.

FOR MORE INFORMATION contact your nearby G-E Apparatus Sales Office or authorized distributor . . . or write for bulletin GEA-5878 to General Electric Company, Section 625-2, Schenectady 5, N. Y.

LIVE BETTER ELECTRICALLY

Building Tomorrow's Turbine-generator Today



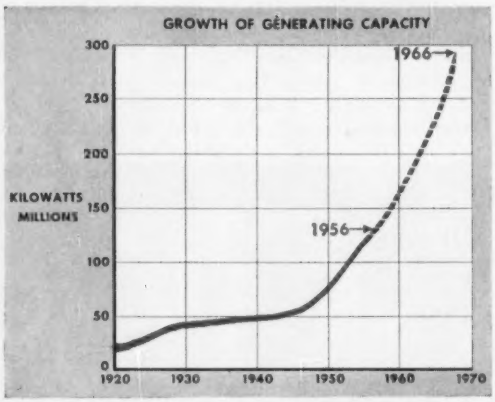
THE HIGH-PRESSURE END DIAPHRAGM WEBS are made from heavy alloy steel plates or castings. Some are ten inches thick and can withstand high pressure drops and maintain close clearances.

THE WEB is then carefully machined for welding (top). Nozzle partitions are machined from solid chrome-iron alloy and assembled in punched bands (bottom).

How General Electric builds sturdy nozzle-

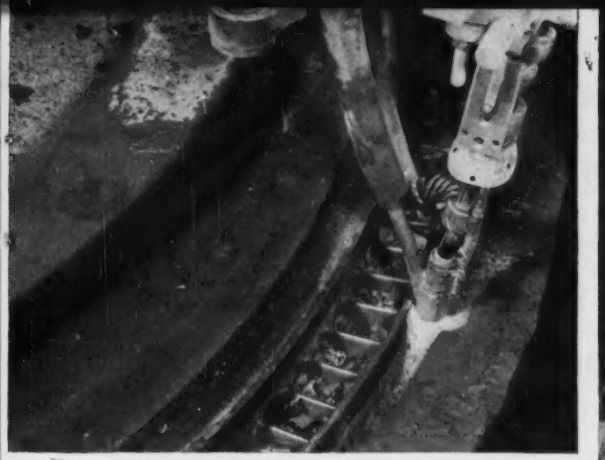
GENERAL ELECTRIC MAINTAINS a continuing program of research on turbine diaphragms. This smoke tunnel provides a visual indication of how steam flow will follow new nozzle designs.

TO MEET TOMORROW'S EXPANDING LOADS

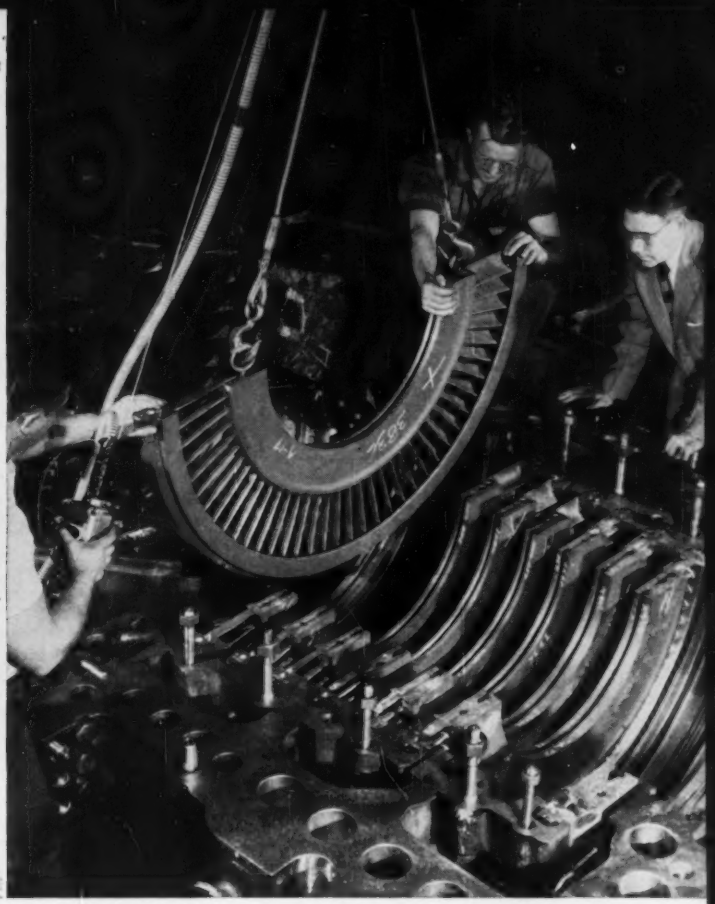


G.E. works with electric utilities and consulting engineers in these vital turbine-generator areas:

BASIC RESEARCH
APPLIED RESEARCH
PRODUCT DEVELOPMENT: **NOZZLE-DIAPHRAGMS**
TESTING
MAINTENANCE



THIS NOZZLE assembly is welded to the web and outer ring (top). A finishing operation puts a high polish on the partitions for a smooth steam path (bottom).



DIAPHRAGM HALVES are lowered into the turbine shell. The rotor is then assembled and the upper shell containing the top half of the diaphragm is added to form a series of complete compartments.

diaphragms to reduce turbine maintenance

TOUGH CONSTRUCTION HELPS PROTECT STEAM PATH AGAINST DESTRUCTIVE FOREIGN MATERIALS

Internal damage to the steam path can be a costly and time consuming cause of turbine shutdown. Should large amounts of foreign material enter the steam path whole rows of buckets and partitions might be severely damaged. This could mean a long and costly outage.

TO HELP GUARD against a long outage, General Electric builds turbine nozzle-diaphragms of tough, sturdy construction. And here's how they help. Should foreign materials enter the steam path, these rugged nozzle-diaphragms "compartmentalize" damage to a small area. This greatly simplifies bucket repairs or replacement.

GENERAL ELECTRIC MANUFACTURES these diaphragms from solid castings or plates carefully machined to shape. Nozzle partitions are machined from solid chrome-iron alloy and welded to, or cast integral with, the webs. These partitions must direct the steam flow at the proper angle and velocity to the adjacent buckets.

In this and many other areas of research G.E. is working with electric utilities and consulting engineering firms to design the power makers for tomorrow's load growth. For more information on General Electric turbines write for GER-905, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, N. Y. 254-40

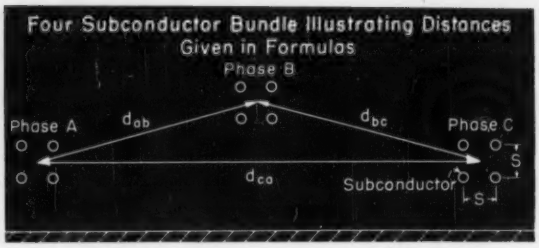
Progress Is Our Most Important Product

GENERAL ELECTRIC

Formulas for Transmission Line Constants of Bundled Conductors

B. L. LLOYD and **C. A. DeSALVO**, Electric Utility Engineering Dept., Westinghouse Electric Corp, East Pittsburgh, Pa.

Accompanying formulas permit calculation of positive, negative, and zero sequence reactances of transmission lines with bundled conductors. The formulas are approximate in that they do not include the slight unbalance in impedances which exists for the usual phase configurations (flat, barrel, etc) but rather provide average values for the three phases. Calculated values will be sufficiently accurate for almost all purposes such as fault, load flow, and stability calculations.



I. Definitions of Terms:

GMR = geometric mean radius of subconductor, feet

GMD = $\sqrt[3]{d_{ab} \cdot d_{bc} \cdot d_{ca}}$; geometric mean distance between centerlines of phases, feet

r = radius of a subconductor, feet

s = separation of adjacent subconductors in a bundle, feet

f = system frequency, cycles per second

$x_a = 0.2794 \left(\frac{f}{60}\right) \log_{10} \frac{1}{GMR}$; inductive reactance of a subconductor due to both the internal flux and that external to the subconductor out to a radius of one foot, ohms per mile

$x_s = 0.2794 \left(\frac{f}{60}\right) \log_{10} s$; inductive reactance of a subconductor due to flux from a radius of one foot to a radius equal to s, ohms per mile

$x_d = 0.2794 \left(\frac{f}{60}\right) \log_{10} GMD$; inductive reactence due to flux from a radius of one foot to a radius equal to the GMD, ohms per mile

$x'_a = 0.0683 \left(\frac{60}{f}\right) \log_{10} \frac{1}{r}$; capacitive reactance of a subconductor due to electrostatic flux out to a radius of one foot, megohms per mile

$x'_s = 0.0683 \left(\frac{60}{f}\right) \log_{10} s$; capacitive reactance due to electrostatic flux from a radius of one foot to a radius equal to s, megohms per mile

$x'_d = 0.0683 \left(\frac{60}{f}\right) \log_{10} GMD$; capacitive reactance due to electrostatic flux from a radius of one foot to a radius equal to GMD, megohms per mile

Note: GMR, x_a and x'_a can be obtained from tables, Reference 1, pp 49–53.

x_s, x'_s, x_d and x'_d can be obtained from tables, Reference 1, pp 54 and 55.

II. Formulas for Positive and Negative Sequence Inductive Reactance per phase, ohms per mile

A. Two-Conductor Bundle

$x_1 = x_2 = \frac{1}{2}(x_a - x_s) + x_d$

B. Three-Conductor Bundle

$x_1 = x_2 = \frac{1}{3}(x_a - 2x_s) + x_d$

C. Four-Conductor Bundle

$$x_1 = x_2 = \tfrac{1}{4}(x_a - 3x_s) - 0.0106\left(\frac{f}{60}\right) + x_d$$

III. Formulas for Positive and Negative Sequence Capacitive Reactance per phase, megohms per mile

A. Two-Conductor Bundle

$x'_1 = x'_2 = \frac{1}{2}(x'_a - x'_s) + x'_d$

B. Three-Conductor bundle

$x'_1 = x'_2 = \frac{1}{3}(x'_a - 2x'_s) + x'_d$

C. Four-Conductor Bundle

$$x'_1 = x'_2 = \tfrac{1}{4}(x'_a - 3x'_s) - 0.0026\left(\frac{60}{f}\right) + x'_d$$

IV. Zero Sequence Reactances

Zero sequence reactances for bundled conductors can be obtained by using the zero sequence formulas given in Reference 1, Chapter 3, for single-conductor circuits if x_a and x'_a in the formulas are replaced with the equivalent x_a and x'_a of the bundle. Following table lists formulas for 2, 3 and 4 subconductors.

Subconductors	Equivalent x_a (ohms per mile)	Equivalent x'_a (megohms per mile)
2	$\frac{1}{2}(x_a - x_s)$	$\frac{1}{2}(x'_a - x'_s)$
3	$\frac{1}{3}(x_a - 2x_s)$	$\frac{1}{3}(x'_a - 2x'_s)$
4	$\frac{1}{4}(x_a - 3x_s) - 0.0106\left(\frac{f}{60}\right)$	$\frac{1}{4}(x'_a - 3x'_s) - 0.0026\left(\frac{60}{f}\right)$

REFERENCE:

1. Electrical Transmission and Distribution Reference Book; Westinghouse Electric Corp, East Pittsburg, Pa., 4th ed., 1950.

Capacitor Inrush Currents Obtained Faster

H. C. STONE, Development Engineer, Capacitors, Line Material Co, Milwaukee, Wis.

Simplified formulas and curves, based on fundamental equations, today expedite determination of inrush current amplitude and frequency to multi-step capacitor banks.

In the past, lengthy mathematical equations were required for determining inrush currents and their frequencies. Increased use of multi-step banks in shunt capacitor installations has necessitated speedy, reasonably accurate calculations so ratings and duty requirements of switchgear may be ascertained readily.

Experience has shown that the usual inrush to a single isolated bank is from 5 to 15 times normal capacitor current. Switching of a multi-step bank, however, results in an inrush current 20 to 250 times steady-state capacitor current.

Decays Quickly

In the case of a single isolated bank, inrush current depends upon the inductive reactance between the bank and the source. For multistep banks, the predominant inrush current generally is produced by adjacent banks already energized that discharge into the newly switched step. This inrush current, therefore, depends upon only inductive reactance between steps and voltages at the time of switching.

Inrush current due to adjacent banks decays to an insignificant value in less than a cycle on a 60-cps basis, and often it decays to a low value within one-half cycle. Depending upon the capacitor switch used and the speed of contact closing, the transient may exist entirely during the prestrike period of closing.

Magnitude of maximum inrush current to a floating-neutral or delta-connected two-step bank may be determined by the equation:

$$I_{peak} = \frac{1770\sqrt{kvar}}{\sqrt{L_o}}$$

For a grounded-wye bank, maximum inrush current is approximately 87%

(*Continued on page* 112)

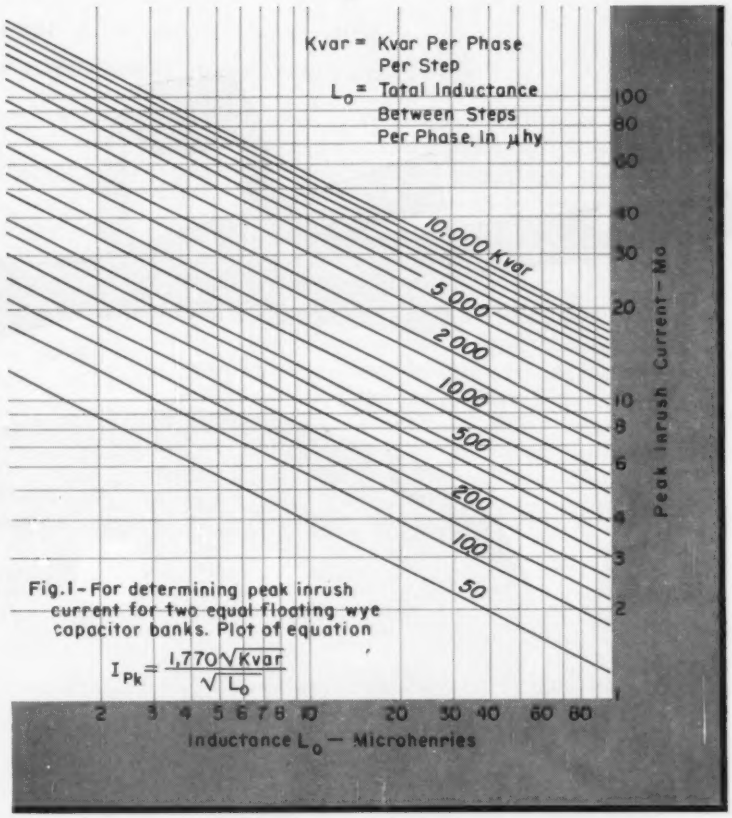


Fig. 1—For determining peak inrush current for two equal floating wye capacitor banks. Plot of equation

FIG 1—DETERMINATION OF PEAK inrush currents for two equal floating wye capacitor banks is by curves based on formula $I_{PK} = 1770 \sqrt{Kvar} \div \sqrt{L_o}$

Table I—Approximate Inductances

Item	L
Single overhead conductor	0.33 μh/ft
3-phase cable	0.09 μh/ft
Single-phase NR switch (15 kv, 200 amp)	0.8 μh
3-phase VR switch (15 kv, 400 amp)	1.2 μh
Capacitor bank (two rows of units with standard spacing)	1.0 μh*
Circuit breaker	Z_ **

*Number of parallel units immaterial. This value may be used for block or pole-mounted banks.
**Obtain value from manufacturer.

Table II—Multiplying Factors

No. of Equal Steps	Factor Mp
2	1.00
3	1.33
4	1.50
5	1.60
6	1.67
∞	2.00

DISTRIBUTION TRANSFORMERS

THIS PAINT

COULD SAVE YOU $15 to $160

Estimate your possible savings in terms of all transformers on your lines

Super Melaglyp, the new G-E paint, gives 50 per cent longer life than the previous finish under normal conditions, and up to 150 per cent longer life under corrosive conditions. This longer paint life means that you save one, perhaps two repaintings. At an average repainting cost of $15 per transformer, that amounts to a real saving.

In areas where corrosive industrial "smog" and other chemical fumes literally eat an ordinary finish down to the base metal, Super Melaglyp makes possible even more dramatic savings. For ordinary paints under such conditions may even cause a transformer to fail. In one case, a 5-kva, 7200-volt transformer, battered by spray in a remote seacoast location, rusted, leaked, and failed. Cost of service trip plus replacement added up to $160.

Developed in G-E laboratories after more than four years of experimentation, we believe Super Melaglyp is by far the best outdoor finish available today for distribution transformers.

Look at the other money-saving features that prove "All Transformers Are Not Alike": **Impulse testing,** for instance, saves years of transformer life. One-piece **clamping bands** save maintenance time. Reuseable **Nitrile rubber gaskets** save units from contamination. **AL/CU terminals** are designed to prevent both copper and aluminum conductors from loosening. **Strenicor clamps** save terminals from breaking. **Nationwide warehouses** save utilities inventory expense. **Service shops** can cut your repair and rebuilding costs.

For the complete story contact your nearest G-E Apparatus Sales Office or G-E Agent—or write to General Electric Co., Schenectady 5, N. Y. 431-38

dollar-saving features prove ATANA*

*ALL TRANSFORMERS ARE NOT ALIKE
(make this simple comparison and see)

FEATURE	General Electric	Mfr. A	Mfr. B	Mfr. C	Mfr. D	Mfr. E
Production-line impulse testing	√			√		√
Nitrile rubber gaskets	√					√
One-piece clamping band	√					
H-v and l-v terminals handle both copper and aluminum conductors	√					
Strenicor pressure terminal clamps	√					
Super Melaglyp paint	√					
More than 100 warehouses	√	√				
Nationwide, company-operated service shops	√	√				

Progress Is Our Most Important Product

GENERAL ELECTRIC

NETWORK
TRANSFORMERS
higher kva in same vault space

BALANCED THERMAL DESIGN

for increased life, reduced size and increased loading of network systems

General Electric transformers feature balanced thermal design (BTD), giving reduced hottest-spot temperature rises throughout the transformer core-and-coil structure. Users get these benefits . . .

INCREASED LIFE

Transformer life, in accordance with ASA Guide C57.32 for loading transformers, is increased from 20 to 30 per cent, depending on load, for every 2 C reduction in hottest-spot temperature. We are careful therefore, to maintain thermal balance.

INCREASED LOADING

Since transformer life is a function of hottest-spot temperature, units having BTD are better able to carry the loads normally encountered in network service. G-E network transformers, therefore, permit maximum loading of your network system without reducing transformer life.

REDUCED SIZE

With BTD, transformer designers can make the most efficient use of materials. G-E BTD units are as much as 17 per cent smaller than comparable units without BTD—you can put additional transformer kva in the same vault space saving on construction costs.

HOW BTD IS ACHIEVED

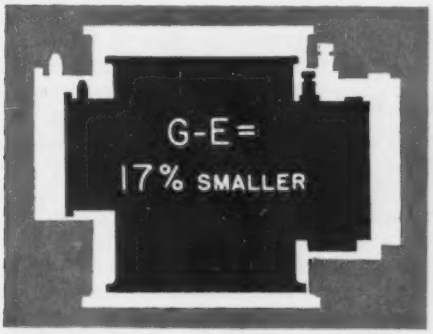
G-E engineers subject prototype coils to heat runs under carefully controlled conditions to assure thermal balance before putting the final design into production.

The engineers check temperature distribution by means of thermocouples, as shown in photo. Automatic equipment controls load and maintains accurate temperature records throughout tests. Even test room humidity, temperature and drafts are closely controlled to assure accurate tests.

While featuring BTD, G-E network transformers are also designed to withstand overvoltage conditions and short-circuit stresses, thus giving over-all design balance—there are more than 10,000 G-E network transformers now in service.

HELP FOR YOU

For help in solving your network problems, contact your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady, N. Y. 435-7



REDUCED SIZE With BTD, engineers make the most efficient use of materials—G-E units are up to 17% smaller than units without BTD.

INCREASED LIFE Before beginning production, we check designs for thermal balance, even checking contact that joins with network protector.

Progress Is Our Most Important Product

GENERAL ELECTRIC

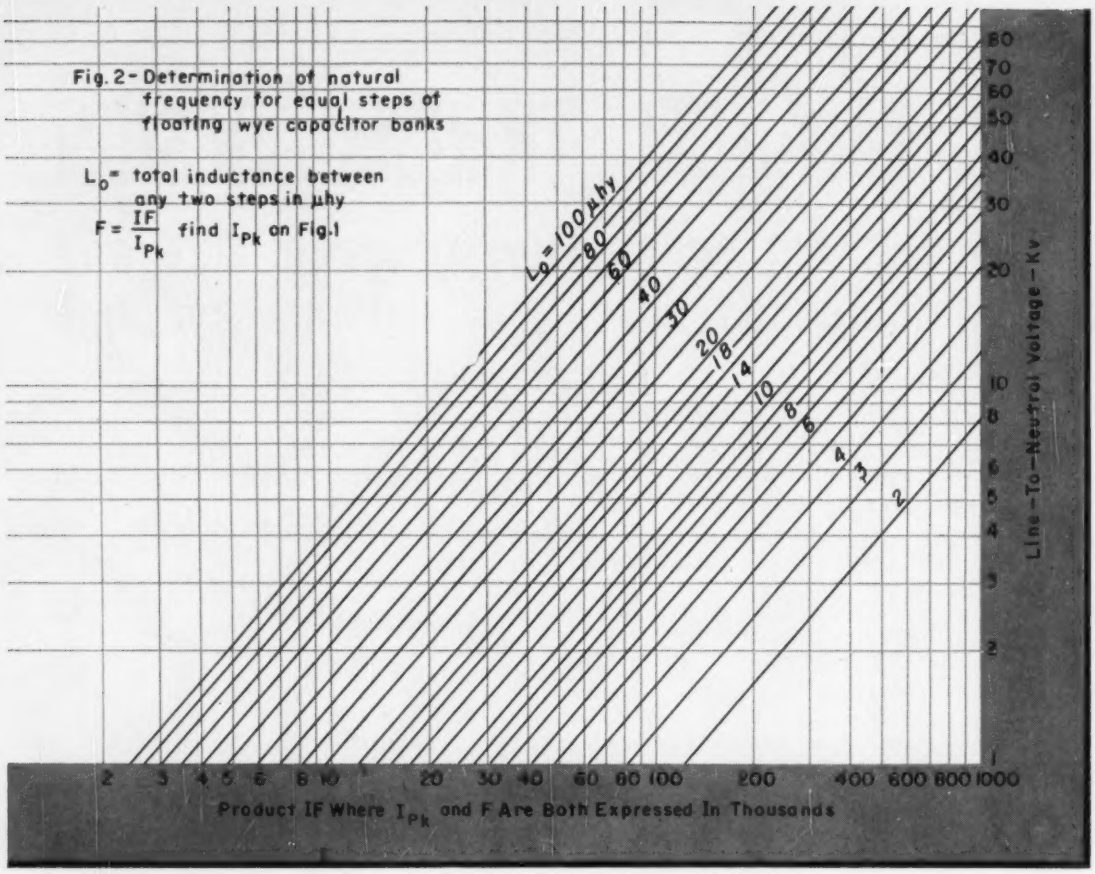


FIG 2—DETERMINATION OF NATURAL frequency of inrush currents for equal steps of floating wye capacitor banks is made easier by curves. L_o = total inductance between any two steps in microhenise. $f_r = K \div I_{PK}$. Find I_{PK} on Fig. 1

(*Continued from page* 107)
of the calculated value.

In this equation kvar represents total rated kvar per phase per step. Inductance L_o is total inductance, in microhenries, between steps, and it includes reactors, if any, as well as the characteristic inductance of a step.

Values of inductance that may be used to obtain L_o are listed in Table 1. Generally these values yield an inrush current slightly higher than actually exists, thereby providing a safety factor.

When more than two steps are switched in parallel, inrush current may be determined by the same equation. Bank connection still must be considered. Inductance L_o becomes the value between any two steps, for steps of equal size and spacing, or it is the lowest value between any two steps, for steps of unequal spacing. Also, because the kvar term represents only the kvar per phase per step, a multiplying factor must be employed to obtain the correct magnitude of inrush current when more than two steps are paralleled. Factors for banks of various steps are listed in Table 2.

Proportional to Voltage

Inrush current is directly proportional to voltage. Therefore, in all cases the calculated value must be corrected when actual voltage differs from rated.

Frequency of the inrush current may be determined by the equation:

$$f_t = \frac{138V_R}{\sqrt{L_o(\text{kvar})}} \text{ cps}$$

In this formula, L_o and kvar are the same as in the inrush current formula, and V_R is the rated line-to-neutral voltage. The equation is applicable for a floating-neutral or grounded-neutral bank, but for a delta-connected bank, equivalent line-to-neutral voltage would have to be used.

Curves, Figs 1 and 2, have been obtained from calculations using the simplified formulas; so they may be used to determine inrush current and frequency. The curve of Fig 1 facilitates determination of inrush magnitude when kvar per phase per step and total inductance between two steps are known. Fig 2 provides the product of frequency and inrush current when the same inductance and line-to-neutral voltage are known. The product ascertained from Fig 2 divided by the inrush current from Fig 1 then provides the frequency.

As an example, a floating-neutral two-step bank can be assumed to be rated 500 kvar per phase per step, 7.2kv, with total inductance between steps of 20 microhenries. Peak inrush current would be 8,800 amp from Fig 1, and the product of current and frequency from Fig 2 would be 88×10^6. Frequency, would be 10,000 cps.

G-E Type AK-1-50 Electrically Operated Air Circuit Breaker, 1600-amperes, 600 Volts, A-C. One pole shown. Made by General Electric Company, Low Voltage Switchgear Department, 6901 Elmwood Ave., Philadelphia, Pa.

Here is the General Electric Type AK-1-50 Electrically Operated Air Circuit Breaker, 1600-ampere frame size used to protect low-voltage systems. The picture shows one pole of the contact, and in order to photograph it, the housing and the arc-quencher parts were removed. Note the Revere Extruded Shapes, and Rectangular Rod. There are three shapes, and one size of bar, all in copper, because copper has the highest electrical conductivity of all commercial metals.

If these shapes had to be "hogged" out of bar, they would be expensive, due to the machining time, and the scrap generated. While copper scrap is readily salable at good prices, it is costly from the machining standpoint. Extruded shapes by Revere, preformed to the desired contours, usually reduce machining to a cutting-off operation, plus such minor details as drilling which cannot be done during extrusion. Shapes naturally cost more per pound than bar or rod, but the ultimate saving makes up for the difference and more, sometimes several times.

Are you doing much machining of copper? If so, look into Revere Extruded Shapes. They may save money, and speed up production as well. See the nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

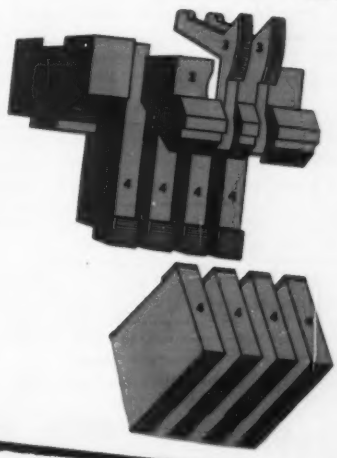
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. —Sales Offices in Principal Cities, Distributors Everywhere

Sketch showing details of contacts. Nos. 1, 2 and 3 are extruded and drawn copper shapes. No. 4 is rectangular copper bar. Cross hatching represents special arcing contacts brazed to the copper.



Save Thousands of Dollars in

Allis-Chalmers Solves Problem of Bushing Interchangeability

...115 kv and above

Now Standardized High Voltage Bushings for Allis-Chalmers Transformers and Circuit Breakers

FOR any voltage class, one spare bushing is probably all you'll need for both Allis-Chalmers transformers and circuit breakers.

Think of what this will mean in savings in reduction of large idle bushing inventories.

Check the chart below for dimensional and rating information.

This is another example of Allis-Chalmers progress in Switchgear and Transformers.

For details on how you can take advantage of this development, call your nearby A-C office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

FLANGE DETAIL

	Voltage Class, Kv	BIL	Current Amperes	LOWER END			FLANGE					TOP END TERMINAL	
							GASKET SPACE		PROVISION FOR BOLTS				
				Length of Bushing from Flange Seat to Lower End	Depth of Curr. Transf. Pocket. Distance from Bushing Gasket Surface to Min. Oil Level	Max. Diam. from 1" Below Flange to Lower End of Bushing	Inside Diameter Maximum	Outside Diameter Minimum	Number	Bolt Hole Size	Bolt Circle Diameter	Length	2-1/2" Useable Threads Class UNF-2A
				L	W	D	P	Q				A	R
	1	2	3	4	5	6	7	8	9	10	11	12	13
*	115	550	1600	42-15/16	23	9-1/2	9-7/8	11-7/8	6	1-1/4	13-1/4	3	2"-12
*	115	550	1200	42-15/16	23	8-3/4	9-7/8	11-7/8	6	1-1/4	13-1/4	3	2"-12
	115	550	800	46-11/16	26-3/4	8-3/4	9-7/8	11-7/8	6	1-1/4	13-1/4	3	2"-12
*	138	650	1600	46-11/16	23	10-1/2	10-7/8	12-7/8	6	1-1/4	14-1/4	3	2"-12
*	138	650	1200	46-11/16	23	9-3/4	10-7/8	12-7/8	6	1-1/4	14-1/4	3	2"-12
	138	650	800	50- 7/16	26-3/4	9-3/4	10-7/8	12-7/8	6	1-1/4	14-1/4	3	2"-12
*	161	750	1600	50- 3/16	23	11-1/2	12-3/8	14-3/8	8	1-1/4	15-3/4	3	2"-12
	161	750	800	53-15/16	26-3/4	11-1/2	12-3/8	14-3/8	8	1-1/4	15-3/4	3	2"-12
*	196	900	1600	59- 9/16	26-3/4	14-5/8	17-1/8	19-1/2	12	1-1/4	21	3	2"-12
	196	900	800	59- 9/16	26-3/4	14-5/8	17-1/8	19-1/2	12	1-1/4	21	3	2"-12

* Interchangeable between transformers and circuit breakers, suitable for draw leads at reduced current ratings.

NOTE: Oil gauge and capacitance tap are in line halfway between flange bolts.

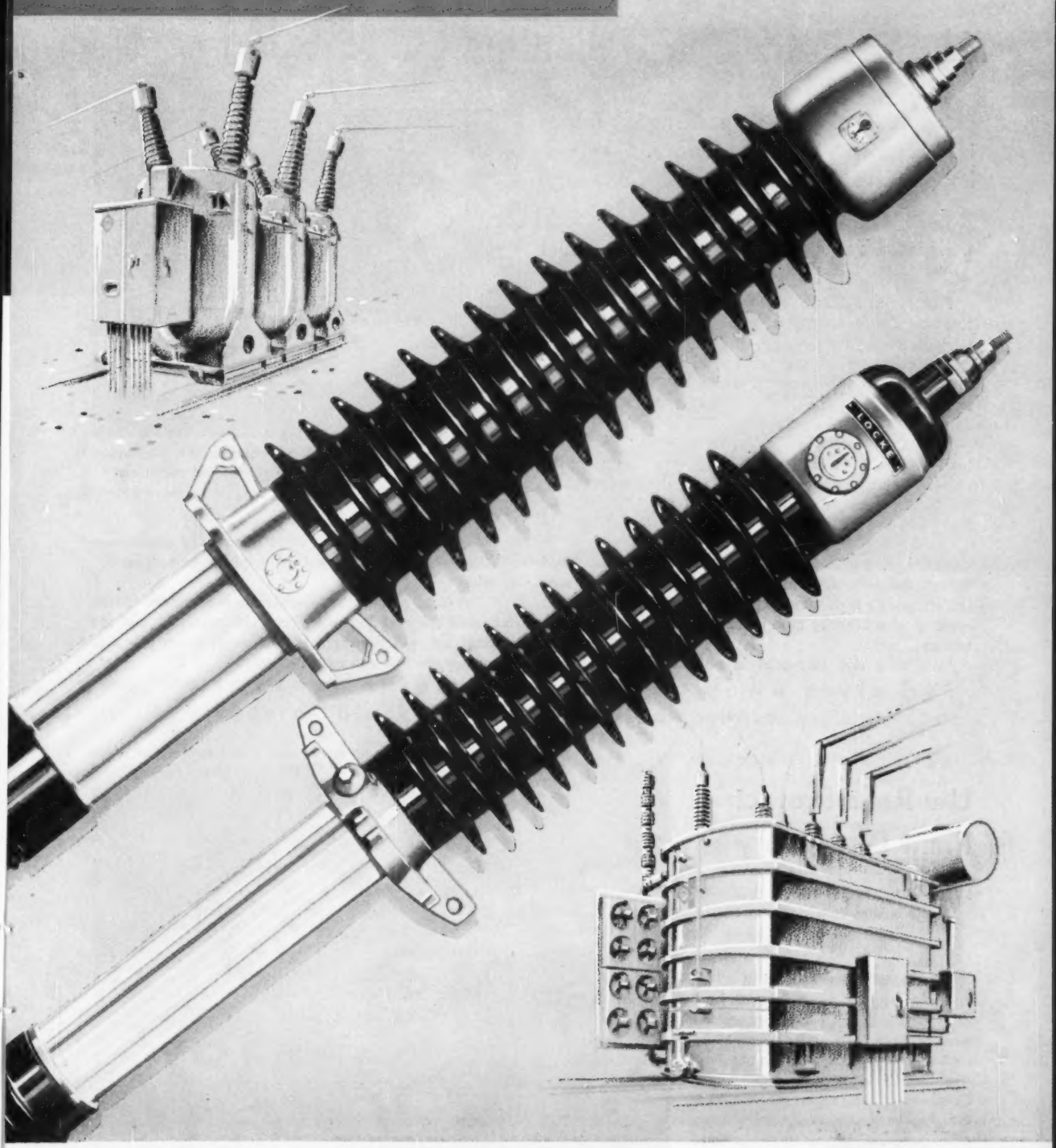
The problems of interchangeability have been worked out for both the Ohio Brass and Locke bushings, either of which can be furnished with Allis-Chalmers transformers and circuit breakers.

A-C ALLIS-CHALMERS

ALLIS-

A-5092

Bushing Inventory



CHALMERS

LIVE BETTER ELECTRICALLY

Fluorescents Raise Illumination to 50 Ft-c

Result: Employees cut patterns in rubberized cloth with greater accuracy. They are happier and waste less energy because they see better

T. K. WALKONEN, Sales Technical Representative, Consolidated Edison, New York, N. Y.

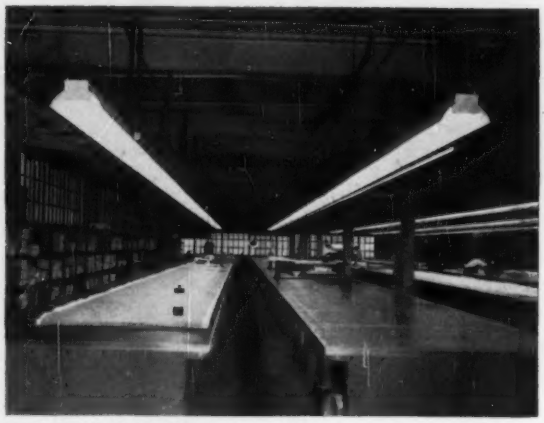
Fluorescent lights have upgraded illumination from 12 to 55 ft-c over tables where rubberized cloth is cut at I. B. Kleinert Rubber Co's plant in College Point, N. Y.

The company occupies several buildings which have been lighted by 200-w incandescent units supplied from an isolated dc plant. A changeover now is being made to ac supplied by Con Edison.

As part of its modernization, the company will install high-level fluorescent lighting in all production departments. The first change was made in the cutting room where 65 two-lamp, 75-w units were installed. In the next 2 yr, the company plans to install about 100 kw in fluorescent lighting.

Henry J. Fine, factory manager, reports that even though the work done under the old lighting system met the company's high standards, the new system has enabled employees to improve even more their accuracy in cutting patterns.

"We were also interested in obtaining the many intangible benefits that come from the improved atmosphere created by the new high level fluorescent lighting system," he said.



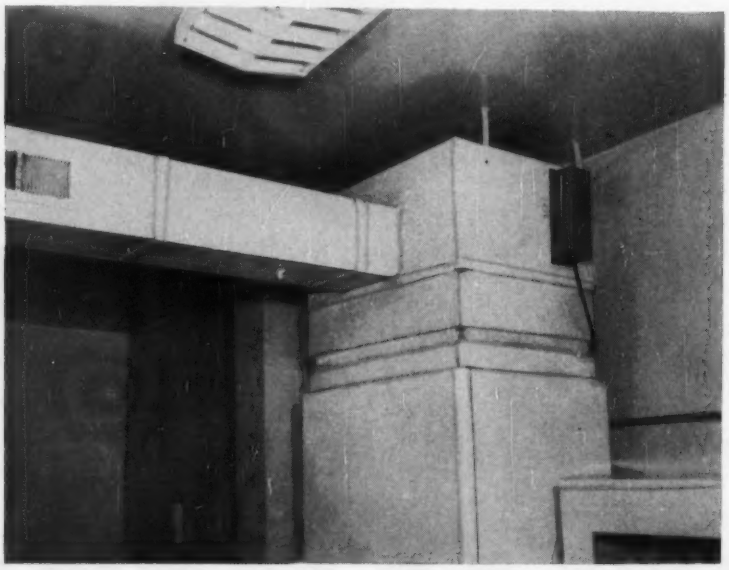
NEW FLUORESCENTS over cutting tables enable employees to cut patterns more accurately in rubberized materials

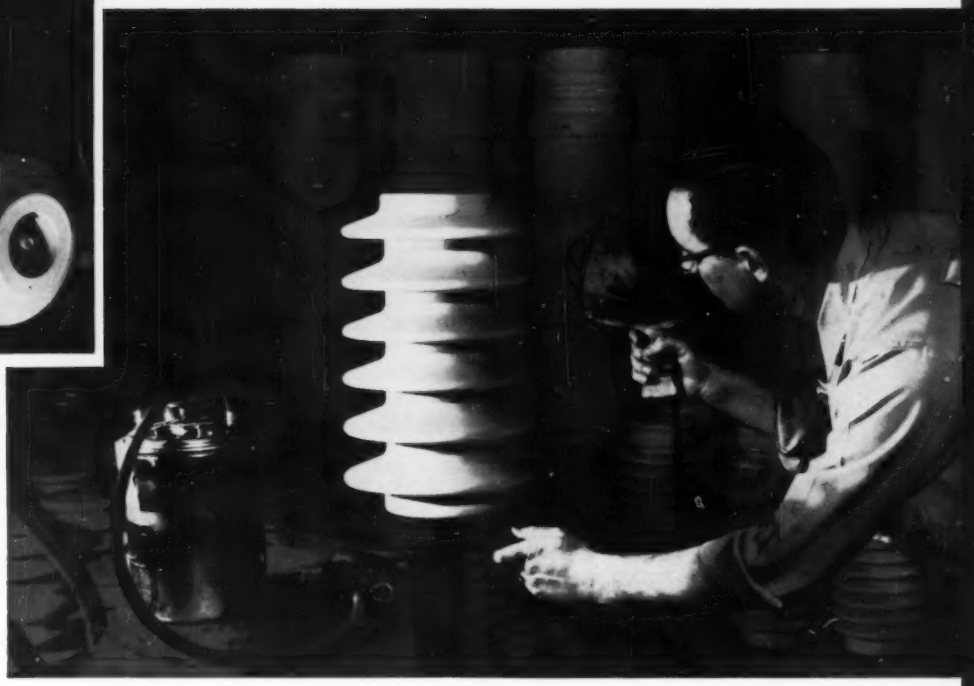
It has been shown that workers in well-lighted plants feel more cheerful and work better because they can see better. They waste less energy and make fewer mistakes when they see fast and easily.

U-v Rays Protect Plant Dispensary

LEON ALBERTSON, Market Studies & Service Division, Philadelphia Electric Co, Philadelphia, Pa.

Ultraviolet lights installed in an air conditioning duct are helping to keep Steel Heddle Mfg Co's dispensary and personnel offices "healthy." Two 10-in. cold-cathode sterilamps are in the ductwork which serves both departments. Company officials report that the 40-w unit has been effective in minimizing cross-infection by airborne bacteria or when persons with colds are interviewed by personnel officials.





WORRY . . . BY PROXY

How we improve shipments and keep down costs by modern "Black Light" inspection technique

"Shipments and costs aren't *my* problem. Let the manufacturer worry about them."

We're not so sure. Our factory only worries by proxy. It worries about your worries. Minor flaws in insulators present an operating hazard. Major flaws result in production losses, delayed shipments, higher costs. Precise detection of all flaws in early stages of manufacture, therefore, means a lot to the ultimate consumer.

When clay dries in air, shrinkage sometimes produces microscopic checks. When this dry clay is turned to shape, as shown here, the tool may start such a check, or reveal internal defects as material is stripped from the outside.

Since the un-aided eye can't possibly find every microscopic flaw in a pure-white material, we spray the piece with a fluorescent dye and then examine it under "black light." Slight concentration of this dye in any defect shines out brilliantly. Soundness of the piece is determined early in production, while costs are still small, and long before final electrical tests might cut-down shipping quantities.

Now we ask, "Don't you have a *real* interest in modern inspection methods?"

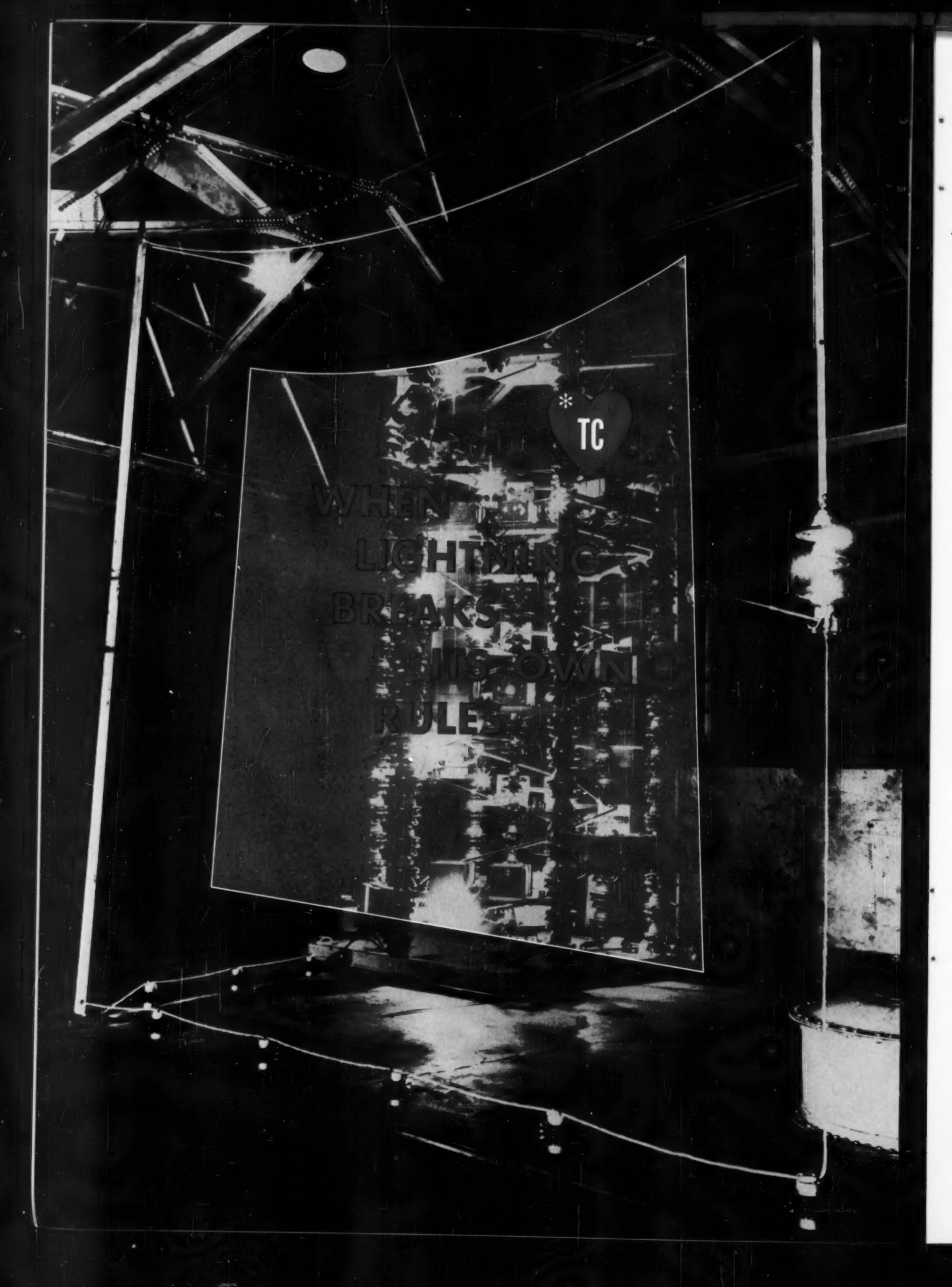
In these days, everybody makes some improvements. But there is still the choice of being driven to it, or actually meeting progress more than half way. This is an important element of Technical Competence, the heart of every O-B insulator.

OHIO BRASS COMPANY, MANSFIELD, OHIO

In Canada—Canadian Ohio Brass Co., Lt'd., Niagara Falls, Ont.

TECHNICAL COMPETENCE

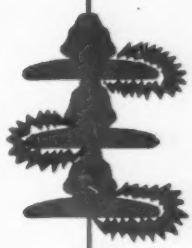
the heart of every Ohio Brass insulator


TC
WHEN
LIGHTNING
BREAKS
ITS OWN
RULES

GENERATOR DISCHARGE
8,000 KV PER MU-SEC WAVE FRONT

STEEL TOWER LEG

FLASHOVER REQUIRING
AT LEAST 345,000 VOLTS



LOOK AGAIN . . . First, this may appear merely to be three suspension insulators on impulse flashover -- a very commonplace event in a laboratory. But study the hook-up. In parallel with, and "shorting-out" these insulators is 22 feet of steel tower leg! According to published 1½ x 40 mu-sec ratings, it takes 345,000 volts at critical flashover level to flash these insulators. How did this considerable voltage build up in a system having a "dead short" across the insulators?

For years, there has been reasonable correlation between estimated lightning outages and actual performance on steel tower lines. Basically the same design of tower, except for greater height, has recently been employed on some of our heavy extra-high-voltage construction. Some of these lines have sustained lightning outages many times in excess of the estimated rate and out of all relation to past design experience. What is the reason? The "dead-shorted flashover" in our picture contains many elements of the answer.

Day and night for months, the O-B High Voltage Laboratory has been at grips with this problem -- a matter of major concern in modern transmission developments. We've been writing our textbooks as we go. It's all unexplored territory. The first concrete results of this extremely interesting research have just been published in a new AIEE paper.*

One of the necessities in such a project has been the production, control, and recording of phenomenally-steep impulse wave fronts in order to simulate lightning. But the big part of the story is not concerned with equipment and facilities but with the quality of manpower, and the progressive attitude of management that makes possible such advanced research. And it is also true that all these factors leading to a high degree of Technical Competence are likewise available to every-day problems of design that have given O-B insulators such a wide margin of performance and value.

*AIEE Paper 56-201, "Anomalous Flashovers On Transmission Lines," by C. J. Miller, Jr., Ohio Brass Company. Presented Feb. 2, 1956 before Winter General Meeting in New York. Copies available on request to Ohio Brass Company, Mansfield, Ohio.

* TECHNICAL COMPETENCE

the heart of every Ohio Brass insulator

TECHNICAL COMPETENCE

The factory produces glaze compounds by the ton in these huge ball mills (above). The experimental pilot plant, however, exactly duplicates the process in batches of a few pounds. Here, there are no cost penalties for mistakes and no obstacles in the way of developments and improvements.

SCALING-DOWN TROUBLE

TIME

COST

This "Factory in Miniature" opens the door to development

Glazing insulators takes an uncommon amount of watching -- and we don't mean just looking! Both the material and the process are sensitive to slight changes.

We could, of course, make up test batches on our huge production equipment. We could throw away tons of rather expensive material. We could tie-up the factory while we tried a new compound or new method. Or, we could go the other direction and let well enough alone until trouble caught up with us. In our book, this isn't how to make insulators!

O-B has a rather unique answer -- a factory within a factory -- the Experimental Pilot Plant where every process is done in miniature, but done to such perfect scale that findings can be transferred directly to production operations. Here we make glaze by the pound, rather than the ton. Mistakes cost dollars instead of thousands. Right answers come quicker. We can keep a watchful eye on every detail, all the time, and no obstacles stand in the way of putting men's imagination to work.

This Pilot Plant operation is just one of many elements that add up to Technical Competence, the heart of every O-B insulator.

OHIO BRASS COMPANY, MANSFIELD, OHIO
In Canada—Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

4656-H

Ohio Brass

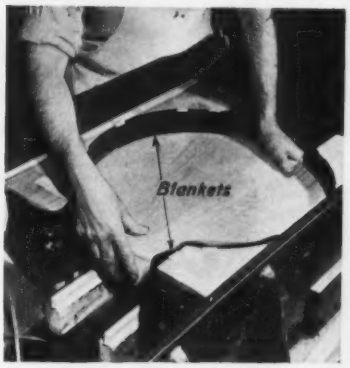
TECHNICAL TC COMPETENCE the heart of every OHIO BRASS insulator

Photos by U.S. Rubber Co

Blanket is tacked in form . . .

Glue is brushed on . . .

Veneer is tacked to table . . .



And top is cured in form

Industrial Heat Blankets Up Output 600%

Electric blankets for industry have been created for such jobs as ice-melting, glue curing, plastic preheating, speeding chemical reactions, incubating, and dehydrating. A Michigan furniture maker reports that he is now turning out bent plywood chair backs seven times faster by using a blanket under pressure between the plywood and mold.

The blankets are made of a thin layer of electricity conducting rubber laminated between two sheets of insulating rubber. Current flows in one edge of the blanket via a flat conductor, crosses through the rubber and flows out the other edge.

Blankets will hold a thermostatically controlled temperature of 220F, operating on 115 or 230 v in almost any wattage. About ⅛ in. thick, they weigh 8 to 16 oz per sq ft. They can be bent around corners, stuck into crevices, wrapped around objects or applied between surfaces and put under pressure. They can be glued to almost any surface, and nailed or stapled along their edges.

Pictures above show an employee at Baker Furniture Co, Holland, Mich., applying French cherry veneer to the side of a round lamp table. He tacks the blanket to a form, driving tacks outside the conducting area. Next he applies resin glue to a 3-ply veneer strip 3/32 in. thick. He tacks veneer strip in place on one side of the table. The strip covers ¼ of the side. He tacks another strip to the opposite side. Then he puts the table top, with its two veneer strips, in an air press which exerts 80 psi. Electric blankets are heated to about 163F. The glue cures in about 6 min. The table top is then removed, the other two veneer strips are added, and the curing process is repeated. This finishes the sides of the table top.

(*More Industrials on page* 122)

Crapo
GALVANIZED STEEL
STRAND

Strong...
to support pole structures under adverse ice and wind loadings.

Rugged...
to withstand the punishment incurred in construction and service.

Long-Life...
provided by famous Crapo Galvanized heavy, ductile, tightly-bonded zinc coatings.

and Economical, Too!

● Each size and grade of time-proved Crapo Steel Strand utilizes the superior tensile strength of steel to the fullest advantage. Next time, *specify Crapo Steel Strand* for guys, messenger and overhead ground wires . . . and *save on maintenance!*

REINFORCE and PROTECT YOUR CONDUCTORS with Preformed ARMOR RODS

Minimize wear and chafing . . . Absorb and dissipate vibration . . . Protect against arcing and flash-overs . . . Increase holding power against slippage . . . Lessen possibilities of corrosion . . . *Reduce overall maintenance costs.*

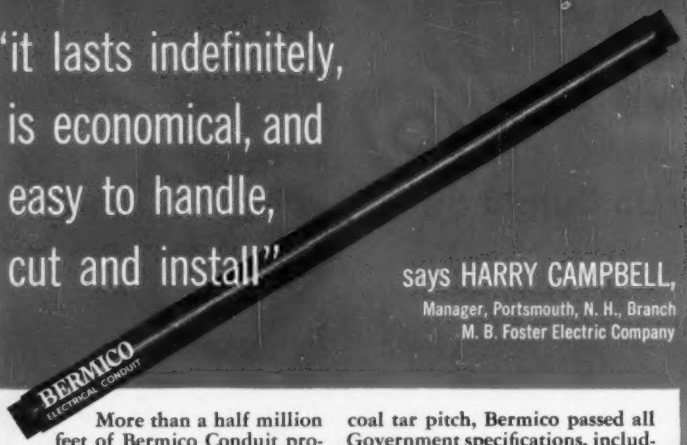
Contact your jobber of Crapo Galvanized Products or write direct for further information!

INDIANA
STEEL & WIRE COMPANY
MUNCIE, INDIANA

BERMICO® electrical conduit was installed at Portsmouth Air Force Base because...

"it lasts indefinitely, is economical, and easy to handle, cut and install"

says HARRY CAMPBELL,
Manager, Portsmouth, N. H., Branch
M. B. Foster Electric Company



More than a half million feet of Bermico Conduit protect the power, communications, runway-light, and control tower cables at the new Portsmouth Air Force Base in New Hampshire.

This Foster Electric official says he believes Bermico will serve the huge Strategic Air Command Base indefinitely.

Made to precise standards from cellulose fibre impregnated with coal tar pitch, Bermico passed all Government specifications, including heat resistance, uniformity, length-, crushing-, chemical-, and boiling-resistance, plus resistance to water absorption and flattening.

For best protection and utmost ease of installation, do what leading electrical contractors and public utilities everywhere do. Specify Bermico Conduit. Immediate shipment of all sizes and fittings.

Distributed by WESTINGHOUSE Electric Supply Company
Offices in principal cities

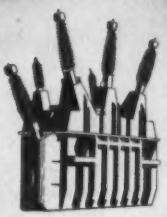
BROWN COMPANY
Berlin, New Hampshire
GENERAL SALES OFFICE: 150 CAUSEWAY STREET, BOSTON 14, MASS.

INDUSTRIAL BRIEFS

Drying synthetic glue on envelope tabs is done with infrared heating units at the Arrow Envelope Co plant in St. Louis. Two 1-kw, 220-v, infrared units replaced a gas-fired, forced-air system. The units are 24 in. long and have parabolic reflectors which focus the heat rays in parallel beams giving an even coverage without hot spots. The changeover to the new drying method was justified by savings over the previous method. The infrared units eliminate dirt and produce a clean end product. Installation of more infrared units is planned for the future. A. L. Chiodini Power Sales Engineer, Union Electric Co, St. Louis, Mo.

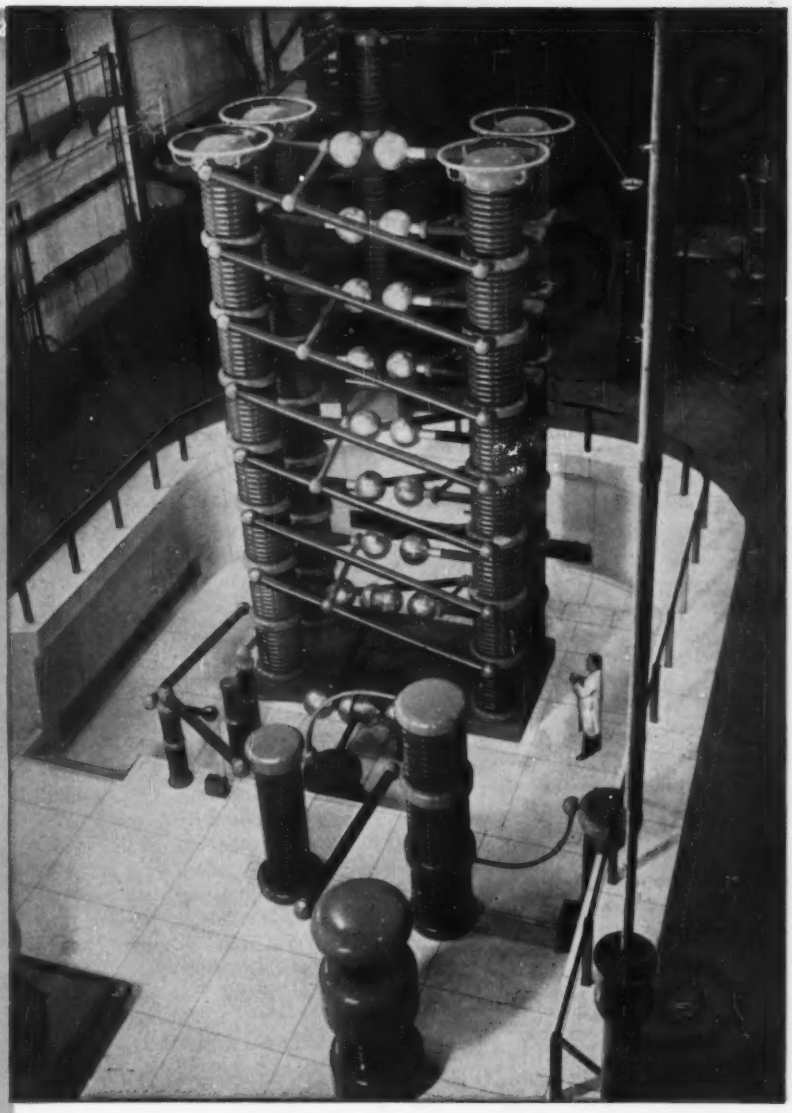
Electric heat has solved a production bottleneck for the Click Burial Vault Co, New Philadelphia, Ohio. In winter and damp weather, the firm was unable to pour cement in burial vault and septic tank moulds one day and remove the product the next day. This meant a definite production schedule could not be maintained. The installation of 160 ft of therm wire inside each mould cavity overcame the company's difficulties. The wire is energized when workers leave in the evening. The following morning the burial vault or septic tank is thoroughly dried and can be removed from the mould. Heat application has also resulted in a more perfect finish on the product. The hit-or-miss element has been eliminated. R. W. Mitchell, Commercial Sales Representative, Ohio Power Co, New Philadelphia, Ohio.

Firing stained glass windows is now done in an electric kiln of 9.6 kw capacity at the Kansas City Art Glass Co works in Kansas City, Mo. The company manufactures leaded, stained glass windows for churches. Designs and painted pictures are fixed on the colored glass by firing in a kiln. The metallic paint is fused into the surface of the glass by temperatures ranging from 700F to 1,100F, depending upon the type of glass. They now produce a better product without the inconvenience of shipping the glass to another city for firing. Cost of the electric kiln installation has been more than justified. A. T. Gaulke, Industrial Engineer, Kansas City Power & Light Co, Kansas City, Mo.



Transformer Capacity of over 5,000,000 kVA per annum

The Ferranti transformer plant at Hollinwood, Lancashire, England, covering an area of over 300,000 sq. ft., has a manufacturing capacity per annum of over 5,000,000 kVA of Large Power Transformers, Distribution Transformers, Voltage Regulators, High Voltage A.C., D.C., and Impulse Testing Plant and Specialised Equipment. Contracts include the supply of transformers for the Garrison Dam and McNary Dam Projects in the U.S.A. and the Alcan Project in Canada.



National Physical Laboratory

This Ferranti Impulse Generator at the National Physical Laboratory, Teddington, England, by whose permission the photograph is reproduced, generates 3,200,000 volts and has an energy rating of 77 kW seconds. This is a typical example of the type of A.C. and D.C. equipment manufactured by Ferranti Ltd., for routine and research testing.

FERRANTI LTD

Head Office and Plant: **HOLLINWOOD · LANCASHIRE · ENGLAND**

OFFICES AND PLANTS FT 160

NEW YORK: Ferranti Electric Inc., 30 Rockefeller Plaza, N.Y. 20
TORONTO: Ferranti Electric Ltd., Mount Dennis, Toronto 15, Ontario
MANCHESTER, ENGLAND: Ferranti Ltd., Moston, Manchester 10
EDINBURGH, SCOTLAND: Ferranti Ltd., Ferry Road, Edinburgh 5

More Help from Distributor?

Sell electric heating and train specialists to see that jobs are installed properly, distributor tells NAED

Utilities may get some help in the mentoring of electric house heating installations if the National Association of Electrical Distributors' Electric Heating Committee has its way.

Committee Chairman R. G. Ely last month urged more NAED members to take on electric heating lines and to train men within their organizations as electric heating specialists.

"In those areas where electric heating is relatively new, the industry should proceed with great care to establish a good reputation for this important new commodity," he said. Consumer acceptance of electric heating can be destroyed unless distributors and contractors provide the public with the type of installation jobs which will provide the maximum in operating efficiency. One man in the distributor organization should be established as an electric heating specialist who can provide the distributor's salesmen with up-to-date technical and promotional information and act as liaison between manufacturer and the electrical heating installation."

While encouraging distributors to handle electric heating, Ely noted that it more and more is being channeled through "other sources of distribution" —notably the contractor. His reasons:

1. Distributors in many areas have not shown enough interest.

2. Electric heating requires a special selling effort and many distributors feel the financial return isn't commensurate with the knowledge and techniques needed to sell it.

Room Coolers Getting Hotter in Windy City

Increasing demand for room air conditioners in northern sectors is evidenced in the Chicago area where Commonwealth Edison Co reports a 53% jump in number in 1955 over 1954.

Number of room coolers installed by residential, commercial, and other customers during the year hit 57,000, to bring the total in service to 165,000. (Figured on the basis of Edison Electric Institute's average 980 kwhr consumption per unit, this could mean a total room cooler load in the range of 162 million kwhr annually).

Annual increases during the past five years have ranged upward of 30%. Commonwealth Ed figures number of units has gone up 5½ times since 1950. The three most popular sizes, it says, are the ½, ¾, and one-hp units.

Central A. C. Gains

Industry sales of residential air conditioning equipment are "substantially higher" than for the comparable period last year, says Cloud Wampler, Carrier Corp board chairman. His forecast: Some 200,000 central systems for homes will be sold this year compared to about 125,000 last year.

BRIEFS

Wisconsin Market Grows

Some 72 electric cooperative members in Wisconsin use electricity as the sole source of heat for their homes, reports Wisconsin REA news. In a survey conducted by the News, 20 co-ops serving areas as far north as Superior (8,000 degree days) reported electrically heated homes on their lines. Costs for a heating season ranged from $110 to $340 with an average of slightly under $200.

U. S. Demand Control Rep Named

C. T. Electrical Controls, Ltd, makers of demand controls used in Canada and approved by various U. S. power authorities where demand rates exist, has appointed Sunwarm, Inc, Kingsport, Tenn., as U.S. representative for two models. The controls are said to be applicable to existing house wiring to prevent over-consumption during peak periods.

New Models for Cooling Market

Chrysler Corp's Airtemp Division has started production on 2-ton waterless central air conditioning system retailing for "less than $750 installed. "The (system) has tremendous mass market sales possibilities," Vice Pres J. F. Knoff said, and will be marketed for as little as nothing down, $5 week.

Westinghouse Electric Corp recently introduced a condensing unit that converts water-cooled air conditioners to air-cooled operation. It works on two, three and five-ton capacities, will get big play in water-short areas.

Glass Tube Heating

Another form of electric space heating equipment—this one a spiralled nickle-chrome element wire in a tough heat-resisting glass tube—is finding success in Great Britain. Standard units can be plugged in, are 5 ft long and rated at 250 w. Heaters, however, can be supplied in any length down to 2 ft. Maker is A & R Electric Co, Ltd, 1, Bruce Ave, Shepperton, Middlesex, England.

New Electric Heater Line

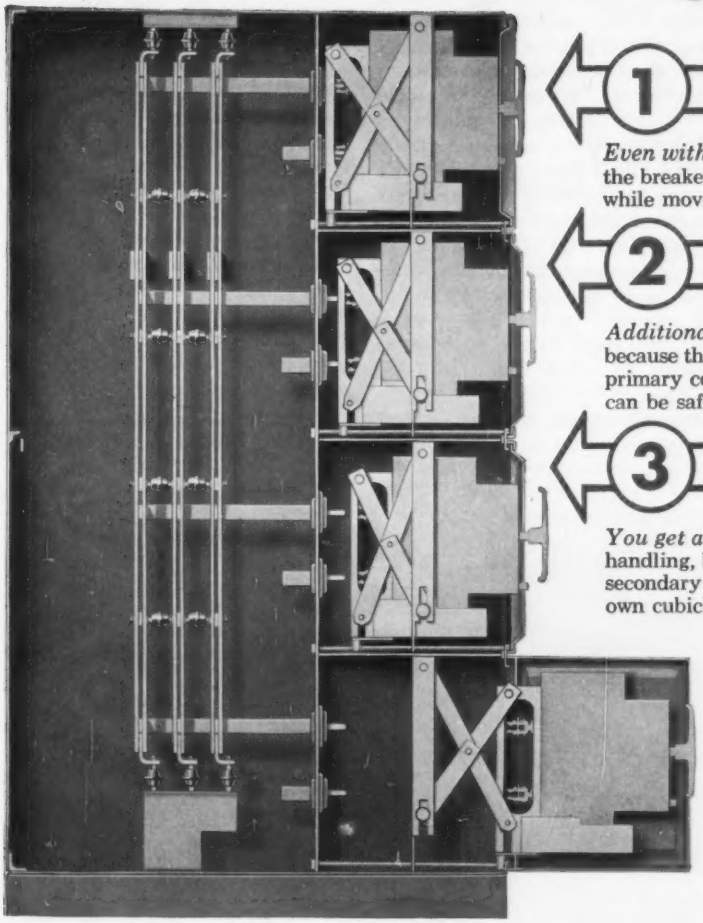
Better heat distribution is claimed for a new "Tri-Core" line of radiant circulating electric heaters announced by Electromode Division, Commercial Controls Corp. Heating element is said to radiate two-thirds of its heat forward.

More Heat Pump Makers

- A ground source packaged heat pump for home use is being introduced by Perfection Industries, Cleveland, Ohio appliance maker. Unit is available in 2½, 2¾, 5, 6, and 7½-ton capacities.
- Gibson Refrigerator Co introduced a new self-contained heat pump.

Positive Protection for YOUR Personnel

Get the Low Voltage Switchgear that's Fully Enclosed in ALL 3 POSITIONS



1 OPERATING POSITION

Even with the door open, dead-front construction of the breaker means complete safety for your personnel while moving breaker in or out of operating position.

2 TEST POSITION

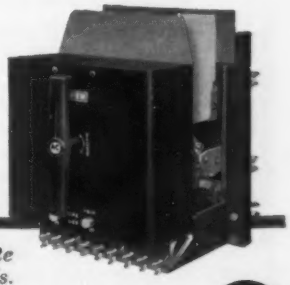
Additional protection for your personnel is assured because the breaker can be moved to test position with primary contacts disconnected, and breaker operation can be safely checked with compartment door closed.

3 DISCONNECTED POSITION

You get added convenience — save storage space and handling, because the breaker, with both primary and secondary contacts disconnected, can be stored in its own cubicle with the door closed.

Inspection also is simplified. In the fully withdrawn position the primary and secondary contacts are clearly visible for inspection without removing the breaker from the cubicle — and it's all done with a convenient, reversible door panel and a rigid, positive-positioning pantograph mechanism.

The breaker provides new flexibility. Long time, short time and instantaneous tripping devices are available. Each is adjustable independently of the other. Selective trip feature available initially or may be added later. Time delay device is sealed, positive displacement type for accuracy. An unusual feature of this new breaker is the faulted phase indicator which tells your operator at a glance on which phase fault occurred. Breaker is dead-front for safety of personnel.



Get more information. Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

A-5055

ALLIS-CHALMERS

Mess in Lamp Retailing

Buyers shop for discounts not good lighting, finds survey. Better trained personal salesmanship is needed

What is it going to take to build greater residential lighting sales?

Some creative person-to-person salesmanship—particularly by fixture and lamp distributors—with the electric utility leading the way, concludes a survey just released by Wilding Picture Productions, Cleveland, Ohio, for General Electric Co's Lamp Division at Nela Park.

Lighting's retail climate could never be more confused than right now, reports the survey. Consumers buy fixtures and lamps not lighting. They shop for discounts. They return merchandise that doesn't look good after it's delivered and in place. The scene of their purchase is usually miles away from their homes—mentally as well as in terms of geography. Adding fire is vacilating pricing policies of dealers or "distributors" plus disasterous competitive bidding of some electrical contractors and too much disinterest in the whole subject by architects and builders.

Sell Complete Job

How to approach the problem? A training program for the actual people who sell lamps and fixtures for the home, suggests the survey report. Such a program would attempt to show profits to be gained by selling complete home lighting not lighting units at random. It would aim to negate the shop-for-discount urge and get the salesman to perform a service for customers that would bind them to the fixture and lamp dealer.

This need for greater salesmanship at the point of sale seems to be recognized within the industry, the report points out, but as yet no one has jelled a plan of attack.

The survey itself is a compilation of 50 questions asked of dealers, supply house distributors, builders, contractors, designers, homeowners and utilities in seven eastern and midwest states and on the west coast. Some of the comments forthcoming serve to show the thinking on home lighting's current condition:

On the market—"The average retailer would double his sales (if he sold home lighting as a package)," says one lighting man. "I get a lot of objection today on the basis of the customer getting a better discount someplace else," complains a distributor. Adds another: "We get a lot of people with a sour taste in their mouths regarding the fixture allowance they're given by the builder." And points out a utility lighting man: "Existing homes are our major problem. The old stuff is the big opportunity for lighting. In very few instances do you have to rewire to get *better* lighting." Points out still another: "There is a lot of modernization going on but we have no program to sell it and it is a big business."

On helping the customer—"Most people want a lot of help in selecting fixtures," said a department store salesman. "They don't know enough to be able to tell a good fixture from a bad one." Echoes a distributor: "It's absolutely true that people will buy better lighting if they can get experienced professional advice. The more our people know about lighting the better they can do. It is quite understandable that women can't go to a fixture or lamp sales room and visualize how an item will look in their homes."

On sales training—"We need more plain salesmanship—how to present the product, the approach to the customer, closing the deal, selling up, etc," admits a midwest retailer. "We certainly could use training," says another. "We once tried to get some dealers to go into a cooperative training program but it wasn't long before the project died."

On door-to-door selling—"I tried it once on a Saturday morning to a group of six-year-old houses" says a

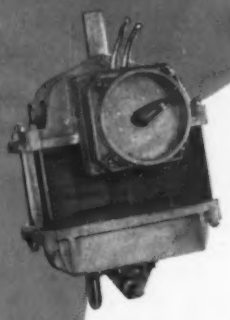
(*Continued on page* 128)

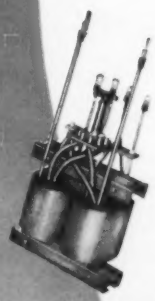
Small Lamps Warm Handy Pie Cupboard

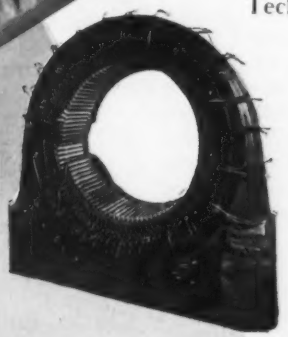
Baked breads and pastries have that fresh-out-of-the-oven taste for Mrs. Harry Wegner's restaurant customers. The Pullman, Wash., cafe owner, shown above, does it with a "pie cupboard" that warms food with three 60-w recessed lamps. A handy device, too, for thawing frozen foods, the homemade cupboard has three stainless steel tray shelves and glass doors. The lamps, underneath the bottom tray, maintain a 100 F temperature. Mrs. Wegner had the device installed in a formerly wasted corner space.

NEW NATVAR ISOGLAS®

for continuous performance at 150°c.







Natvar Isoglas gives heavy duty equipment extra protection against frequent overloads beyond Class B rating. This glass fabric, coated with a newly developed isocyanate type resin is outstanding in its

- resistance to heat
- resistance to crazing and cracking
- resistance to solvents including the askarels
- toughness and abrasion resistance
- wet dielectric strength
- low temperature flexibility
- fungistatic qualities.

Natvar Isoglas may now be used with great savings where expensive Class H materials were formerly used to solve temperature problems during manufacture of transformers, motors, generators, converters, heavy duty relays, reactors and other types of equipment not requiring a Class H rating.

Technical data and samples are available on request.

Natvar

Natvar Products

- Varnished cambric—cloth and tape
- Varnished canvas and duck
- Varnished silk and special rayon
- Varnished—Silicone coated Fiberglas
- Varnished papers—rope and kraft
- Slot cell combinations, Aboglas®
- Isoglas® sheet, tape, tubing and sleeving
- Vinyl coated—varnished—lacquered tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

Ask for Catalog No. 23

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

TELEPHONE RAHWAY 7-8800

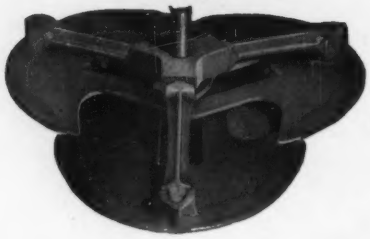
CABLE ADDRESS NATVAR: RAHWAY, N. J.

221 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

The Old Reliable

EVERSTICK ANCHORS...

EXTRA Holding Power
QUICKLY Installed
TOUGH For long life



● They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install—made of tough rust-resistant malleable iron—their holding power "tops" all other. Available two-way, three-way, four-way, and cone types. Write for facts.

AN EXCLUSIVE EVERSTICK FEATURE
Exclusive Everstick nut housing Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO
FAIRFIELD, IOWA

Lamp Sales

(*Continued from page* 126)

fixture manufacturer's representative. "I made $26 in four hours. I used a catalog, took the order, and arranged for the buyer to pick fixtures from a dealer I had selected."

One distributor probably best hit the core of the problem when he concluded: "Just bear in mind that fixtures are not impulse items. People can wait and get them later. They don't casually drop into a lighting store. So you have got to go after them."

Electric Fan Boosts Beef Gains, Saves Feed

Use of an electric fan to cool beef cattle in California's hot Imperial Valley boosted average daily gains of Hereford steers by about one lb. a day, reports the U. S. Department of Agriculture. Other experimental cattle-cooling practices found by the scientists to boost gains—though not as effectively as fanning—included water sprays, air-cooled buildings, cooled roof surfaces, altered feeding practices, wire fencing, and cooled drinking water.

In their test the scientists mounted a 42-inch fan on the corral fence and directed the air flow toward the center and beneath a 10-foot high, hay-covered shade in the corral. The fan delivered 17,000 cu ft of air per minute, resulting in an average 3.7 miles per hr breeze under the shade. The average natural air speed under a similar but unfanned shade was 0.6 miles per hr. The fan did not lower the air temperature under the shade (temperature averaged nearly 90F during the 70-day trial), but it did increase convective cooling by speeding up the rate of moisture evaporation from the bodies of the cattle.

Average weight of seven fanned Hereford steers increased from 669 to 831 lbs. during the 70 days. Average weight of seven unfanned steers increased from 669 to 759 lbs. during the same period. The average daily gain per animal was 2.32 lbs. for the fanned group and 1.29 lbs. for the unfanned animals. For every 100 lbs. of weight gained, the fanned cattle ate 924 lbs. of feed and the unfanned steers 1,330 lbs.

LBE Briefs

Gets Media Help

Arkansas Power & Light Co's plan for getting local media salesmen to help it build dealer cooperation (EW, Dec. 12, 1955, p146) was put to work on a recent LBE special newspaper section the company ran. The more ad space the newspaper salesmen sold to trade allies, the more space AP&L scheduled. Up to 75 in. of dealer space found an AP&L ad of three columns; for 175 in. or more, the utility bought a seven-column space. Supplement featured approximate cost per month for appliances (example: clothes dryer, 60 kwhr @ $2.16).

Uses Spot Radio

Saturation radio coverage on Live Better . . . Electrically features a different appliance every month in eastern Massachusetts. Electric Institute, Inc, uses 750 spots on six stations for each product, plugs three different manufacturers' dealers on one series of announcements, then on successive spots gives the names of others.

Sells Freezers

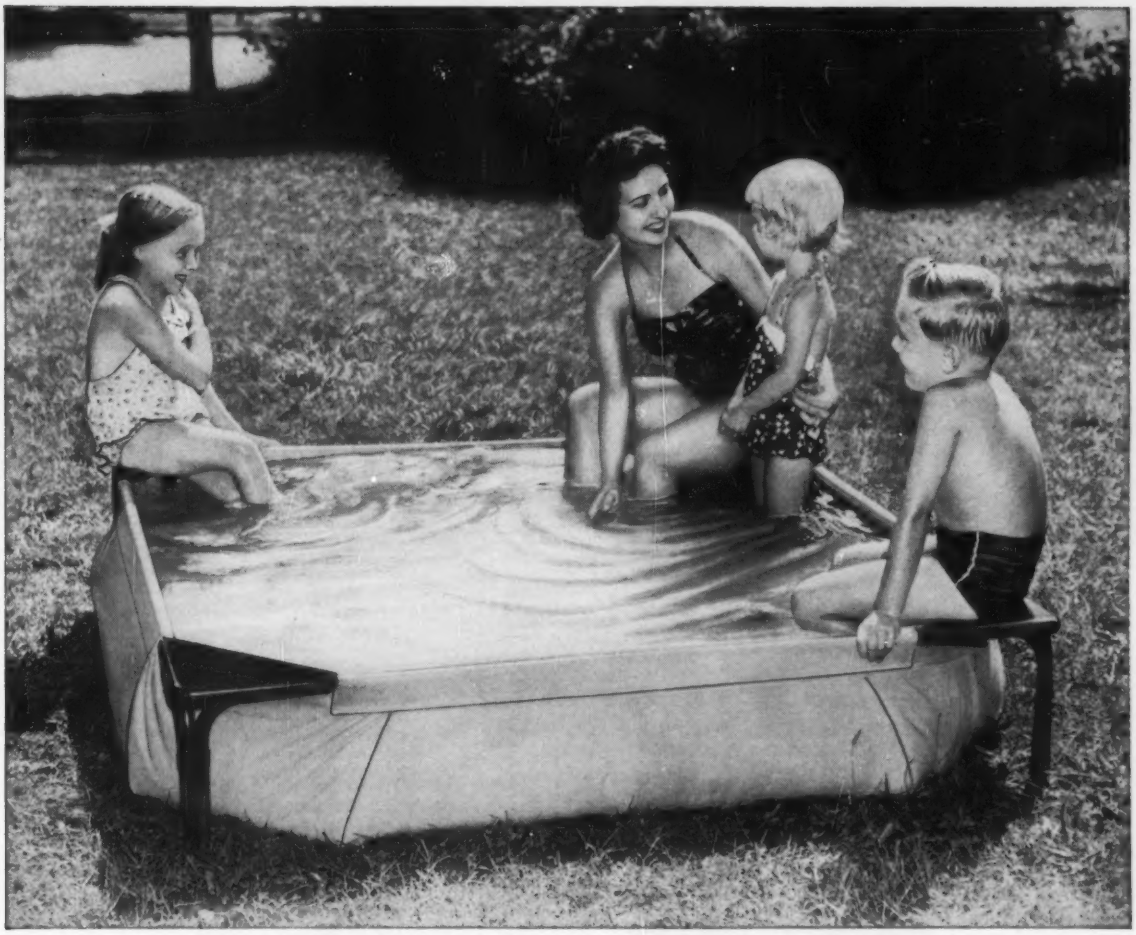
A "Freezer Specials" promotion, tied in with LBE materials, is meeting with success in stores and supermarkets in the San Diego area. Bureau of Home Appliances is sponsoring the campaign and backing it with ads.

Plugs Electric Heat

In Cowlitz County (Wash.) Public Utility District No. 1's LBE newspaper supplement ads featured low-cost angle ($9.10 for 1,200 kwhr), plugged electric heating (one-third of its customers heat electrically).

Clocks Build Load

The electric clock is a real load builder says Puget Sound Power & Light Co. Averaging four per family on Puget's system they use 11½ million kwh annually, and bring an estimated revenue of $137,000. Each clock is rated at 2 w—a continuous 24-hr per day load.



Enjay Butyl—*today's fabulous rubber* gives new life to backyard wading pools

Enjay Butyl brings long life and performance strength to the sensational new Bil-O-Matic®, rubberized fabric wading pool manufactured by the Bilnor Corporation. With its resistance to aging, sunlight, tear and impact damage, the pool manufactured with Enjay Butyl gives outstanding performance. Unlike other pools that cracked and leaked after exposure to sunlight, these *new* pools retain their durability under even the toughest conditions of wear, stress, and weather. The Enjay Butyl label on the carton assures the customer of exceptional quality.

Extremely versatile, Enjay Butyl has led to improved product performance in a wide variety of fields. This amazing, low-cost rubber is *immediately available* in non-staining grades for white and light-colored applications. To find out where Enjay Butyl can *cut costs* and *improve your product,* contact the Enjay Company. Complete laboratory facilities, fully staffed by trained technicians, are at your service.

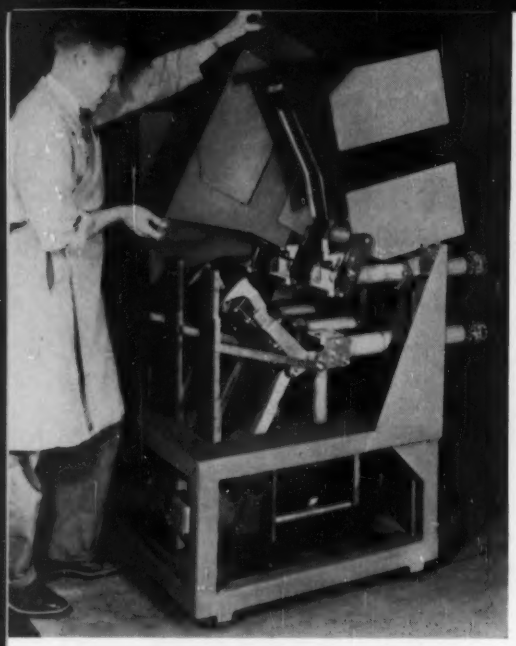
ENJAY BUTYL

Enjay Butyl is the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

ENJAY *Pioneer in Petrochemicals*

ENJAY COMPANY, INC., 15 West 51st Street, New York 19, N. Y.

Other offices: Akron • Boston • Chicago • Los Angeles • Tulsa



5-KV Magnetic Air Breakers

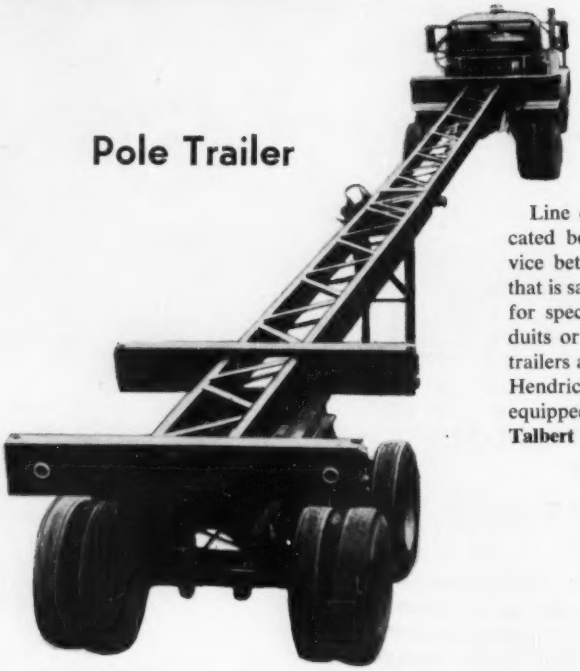
A horizontal draw-out device, this 5-kv, 250-Mva interrupting capacity, magnetic air circuit breaker is designed for use in metal-clad switchgear.

Breaker features include arc chutes which may be tilted back for inspection, a puffer system that assists arc blowout on low current, and a racking-in mechanism said to facilitate breaker insertion and withdrawal from cell.

Designated DST 5-250, the unit is now under production. Other ratings, the company says, will follow.

Federal Pacific Electric Co, Newark 1, N. J.

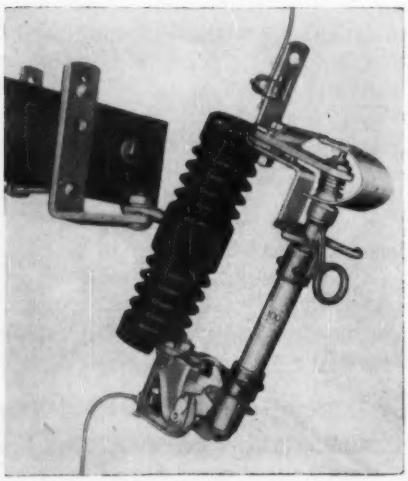
Pole Trailer



Line of pole trailers features fabricated box-type reach (connecting device between trailer axle and tractor) that is said to provide strength required for specialized hauling of poles, conduits or pipe. The 15, 20 and 25-ton trailers are designed with single axle or Hendrickson tandem suspension and equipped with 20-in. or larger tires.

Talbert Trailers, Inc, Lyons, Ill.

Open Distribution Cutouts



Redesigned open-type, single-vented, 100-amp distribution cutouts reportedly possess high fault-interrupting capacity without increase of over-all size. The 7.5-kv XS cutout interrupts currents of 12,000 amp, RMS asymmetrical. Interrupting capability of 15-kv unit is said to be 10,000 amp. Features are a high-strength fuse tube, controlled placement of fuse link, multistep recoil action of upper contact assembly, and recoil-limiting trunnion on hinge assembly.

S&C Electric Co, 4421 N. Ravenswood, Chicago, Ill.

(*More New Equipment on page* 132)

NEOPRENE RESISTS WEATHERING. Cable leading to conduit at relay house is exposed to rain, snow, temperature extremes and ground drainage. Durable neoprene jacket protects cable and adds years of extra service life.

NEOPRENE RESISTS OIL AND CHEMICALS. Neoprene jacket shields buried cable against corrosive effects of soil acids and creosoted board covers. Rugged neoprene gives *long-term* protection.

NEOPRENE RESISTS FLEX CRACKING. Some cables running between troughs are subjected to constant flex. Resilient neoprene shrugs it off, as well as abrasion, chipping and cutting.

PAST PERFORMANCE PAYS OFF!

Delaware Power and Light Company selects NEOPRENE-jacketed cables for new sub-station

Neoprene protects cable at Delaware Power & Light Company's modern Basin Road sub-station—built to handle five 69,000 volt line circuits and to act as a 69,000-12,000 KVA transformer bank for one industrial area in Wilmington.

Years of dependable service at other of the company's installations made neoprene the immediate choice when cable jacketing was selected. Experience had proved to DP&L that neoprene's unique properties withstand the host of deteriorating conditions that a cable must undergo.

Rugged and resilient, neoprene resists the attack of weather, abrasion, galvanic action, oil and chemical corrosion. No wonder DP&L feels secure in using neoprene-jacketed cable above or below ground, in ducts and conduits—*anywhere* cable is needed.

Extra-long service life—that's what it adds up to when you specify neoprene jacketing for the cable or wire you buy. And extra-long life means lowered replacement and maintenance costs. Neoprene-jacketed cable is available in single- and multiple-conductor types and in voltage ratings to meet your requirements. Ask your supplier for further details.

MAIL THIS COUPON TODAY!

NEOPRENE

The rubber made by Du Pont since 1932

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Free! THE NEOPRENE NOTEBOOK. Read how neoprene's resistance to *all* sources of deterioration cuts maintenance costs on products old and new. Actual on-the-job reports are featured in every issue. Clip coupon to get on the mailing list.
E. I. du Pont de Nemours & Co. (Inc.), Elastomers Division EW-7, Wilmington 98, Delaware

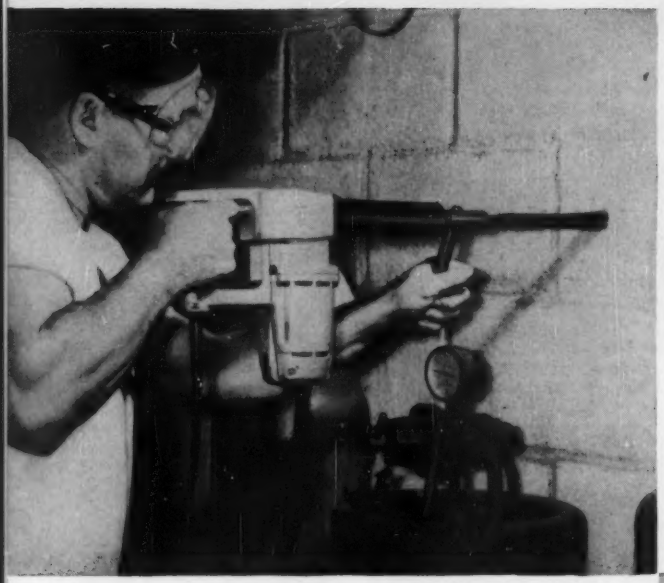
Please put my name on the mailing list for the Neoprene Notebook.

Name _____ *Position* _____

Firm _____

Address _____

City _____ *State* _____



Electric Hammer

A 12.75-lb hammer is said to drill holes in concrete up to 1⅛-in. diam and deliver up to 1,900 blows per minute. Designated H54U, it can also be used on macadam, stone, cinder blocks, wood, metal, tile and earth.

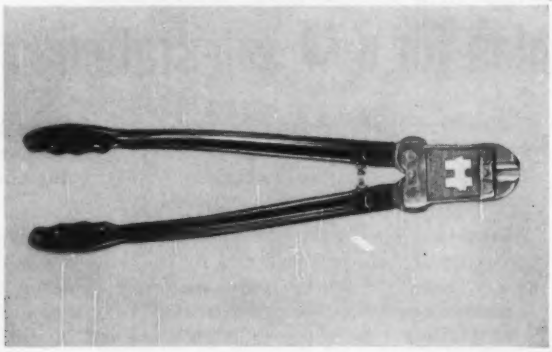
Tool has hardened helical gears and counterbalanced crank assembly. It comes as a standard kit with choice of three accessory kits. Catalog Form 5199 available on request.

Ingersoll-Rand, 11 Broadway, New York 4, N. Y.

Cable Laying Plow

Stabilizing skids are feature of 8-ft, 800-lb cable layer. Plow digs trench, lays cable and backfills in one operation, maker claims. Drawn by tractor or bulldozer, it lays up to 1¼-in. cable to 16-in. depth. Skids reportedly prevent rocking or digging in.

Philadelphia Electrical & Mfg Co, Phila. 21, Pa.



Wire Cutters

These wire cutters feature individually-tested, insulated handles. Covered by a polyvinyl chloride plastisol, handles are tested at 20 kv, though breakdown voltage is closer to 30 kv, manufacturer claims. The covering is intended for added protection on glove work, not "hot" lines.

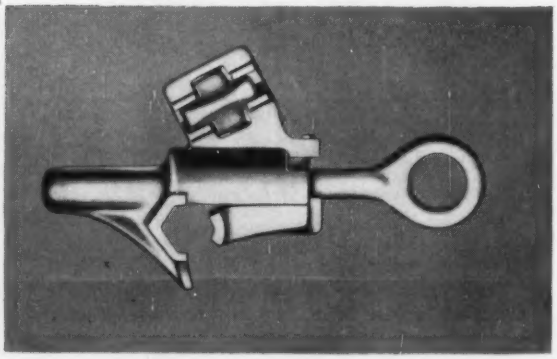
Interstate Drop Forge Co, Milwaukee 16, Wis.

Hot-Line Clamp

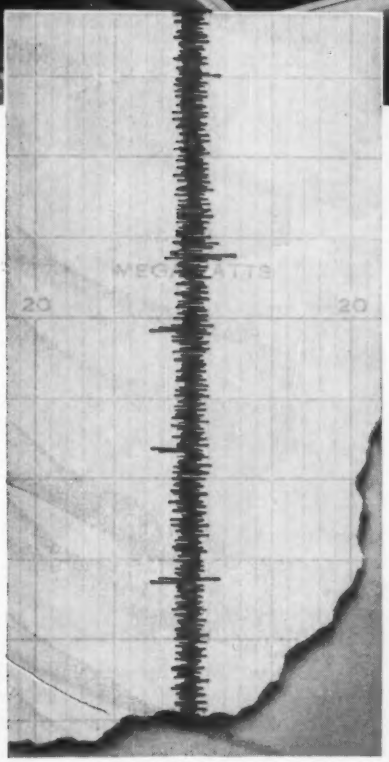
Aluminum-body hot-line clamp is said to stay tight (400-lb torque) without springs or lockwashers. Coating of cadmium and other elements reportedly gives oxidation protection on bi-metal connections. On al-to-al, non-coated clamp is available.

J. A. Weaver Co, 2210 Howard St, St. Louis, Mo.

(*More New Equipment on page* 134)



Two men of the L&N engineering team which makes load allocation a cost-cutting science . . . shown in the Central Illinois Public Service Dispatcher's Office at Pana, Ill.



Actual size section of chart record

They make red ink pay!

To the trained operating engineer, those red curves spell fuel savings. They're charted by the ever-present Speedomax Telemeters and Recorders – integral components of the Leeds & Northrup Area Control installations across the country.

Area Control makes sense to operating men because it's the only load control with the flexibility that lets your Dispatcher allocate generation as required: either on a strictly incremental basis, or in any other manner to meet his area's regulating requirements. Then too, he can at all times schedule interchange precisely with neighboring utilities.

And, the beauty of today's Area Control is that it combines advanced, field-tested equipment (new, faster telemetering; new Area Control allocation circuits; Early-Bird type computers) with application engineering based on *hundreds* of control installations . . . in daily operation. It's the combination offered only by L&N . . . the organization that can make your operating "red ink" pay dividends.

MR.
LINE
SUPERINTENDENT:

WHAT DO
YOU KNOW
ABOUT
RT&E?

As one of the important men who keep power flowing to the nation's homes and industries, you should know something about one of America's leading suppliers of power equipment.

While we are not the largest transformer builder, we are one of the most dependable. We keep your concern for your men and equipment in mind at all times. A little more care on our part will save time for your men and money for your company.

We have several exclusive features that were either suggested by you, or designed to make the work of your men easier and faster. Our externally operated tap changer is standard equipment; our dual voltage transformer is operated from outside the tank. Maintenance and service calls are minimized by our radio noise-proof construction, high overload capacity and lightning surge strength. Our units are guaranteed for five full years.

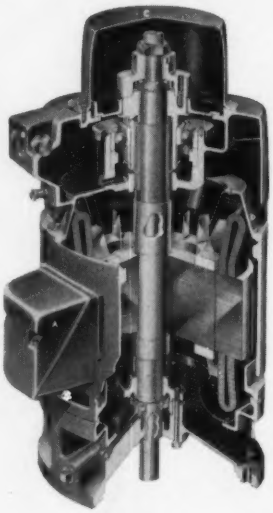
Next time your men go out to install an RT&E Transformer, you can be sure their job will be speedy, simple, and safe.

RT&E CORPORATION
WAUKESHA, WISCONSIN
Equipment to help provide power for America

Belt-Driven Dryer

This Model 56 centrifugal dryer is driven (through two standard v-belts) by a totally enclosed ½-hp vertical flange mounted motor. Its basket revolves at about 500 rpm and will handle loads up to 70 lb.

Hanson-Van Winkle-Munning Co, Matawan, N. J.

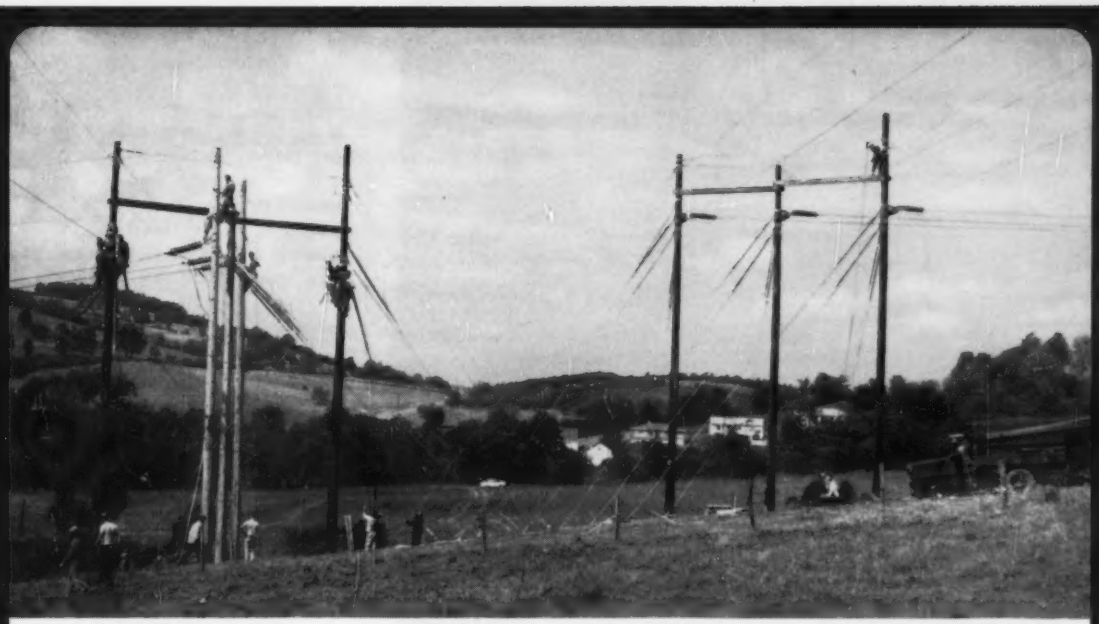


Water Pump Motors

Designed for water pumping applications, a line of vertical, hollow-shaft motors in 7½ through 30 hp have been added to the Tri-Clad 55 line. They feature a gage near the unit's top for quick oil-level checks, top cap permitting access to couplings and bearings, double-end ventilation, and diagonally split conduit box for ample work space.

Lifting lugs are said to permit the motor to be slung quickly with the

(*Continued on page* 136)



New York State Electric & Gas Corporation has been a consistent user of Penta-treated poles and wood members ever since the preservative against decay and wood-boring insects was first introduced. In this picture, line crews erect two dead-end structures in an existing 115-kv line so it can be looped in and out of a new 50,000-kva, 115/34.5-kv substation at Binghamton.

New York Electric & Gas Corp. uses Penta-treated poles for long life

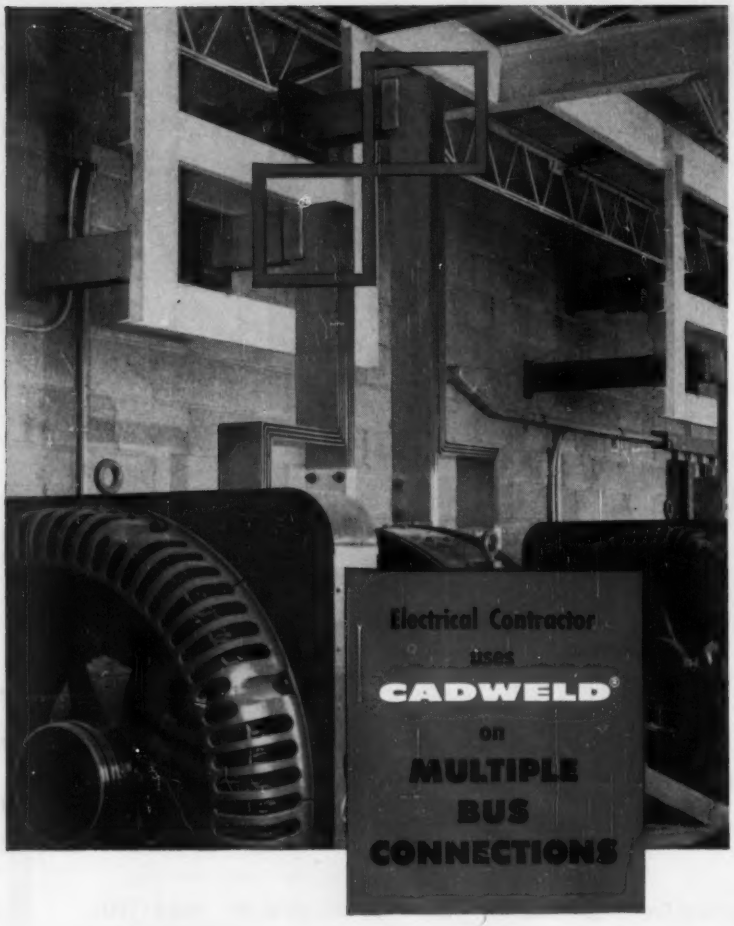
MR. C. R. GILLETTE, TRANSMISSION ENGINEER FOR THE COMPANY, HAS THIS TO SAY ABOUT PENTA: *"For many years we have been replacing the wood members of transmission line structures which have decayed long before the hardware, conductors and related attachments have reached the end of their natural life. In an attempt to bring the life expectancy of all parts of the structure more closely together, we adopted Penta as the preservative for transmission materials. The dry, clean surface of Penta-treated wood is an additional bonus benefit."*

Penta protection can be measured. Penta is a stable, uniform chemical compound. Increment borings taken from Penta-treated poles can be chemically analyzed to determine the exact amount of Penta in wood.

FOR A FREE COPY of "Penta for Poles and Crossarms," write Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Dept. PI-7, St. Louis 1, Mo.

MONSANTO

Where Creative Chemistry Works Wonders for You



Carlson Electric Co., Youngstown, Ohio used CADWELD Electrical Connections on three large multiple bus installations during 1955.

According to Mr. William P. Burkey, Carlson's Chief Engineer;

1. **CADWELD Connections reduce the labor cost.**
2. **CADWELD Connections result in a superior electrical installation that cannot loosen or corrode and is maintenance free.**

Jobs involved various sizes and number of bus, ranging from a splice of ¼" x 2" bus up to a splice of eight ¼" x 6" bus.

Before figuring your next bus installation, investigate **CADWELD.**

CADWELD®

Erico Products, Inc.

2070 E. 61st Place · Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

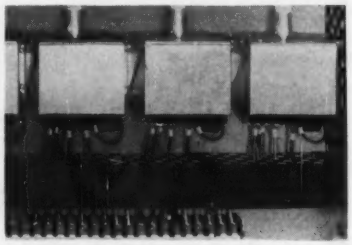
Water Pump Motors

(*Continued from page* 134)

cap on or off. For field service, a machined fit eliminates need for a top cap gasket. Increased thrust capacity can be achieved by removing the spacer ring in the housing and inserting additional thrust bearings.
General Electric Co, Medium Induction Motor Dept, San Jose, Calif.

Machine Tool Relay

This four-pole machine tool relay measures 2⅛ x 3⅛. and is a companion device to manufacturer's two-pole type. Both versions are rated 10 amp, 600 v and have identical baseplates for interchangeable mounting. Plastic impregnated molded coil is said to resist breakage, operate coolly, and is impenetrable by water and oil.
Square D Co, Milwaukee 12, Wisc.



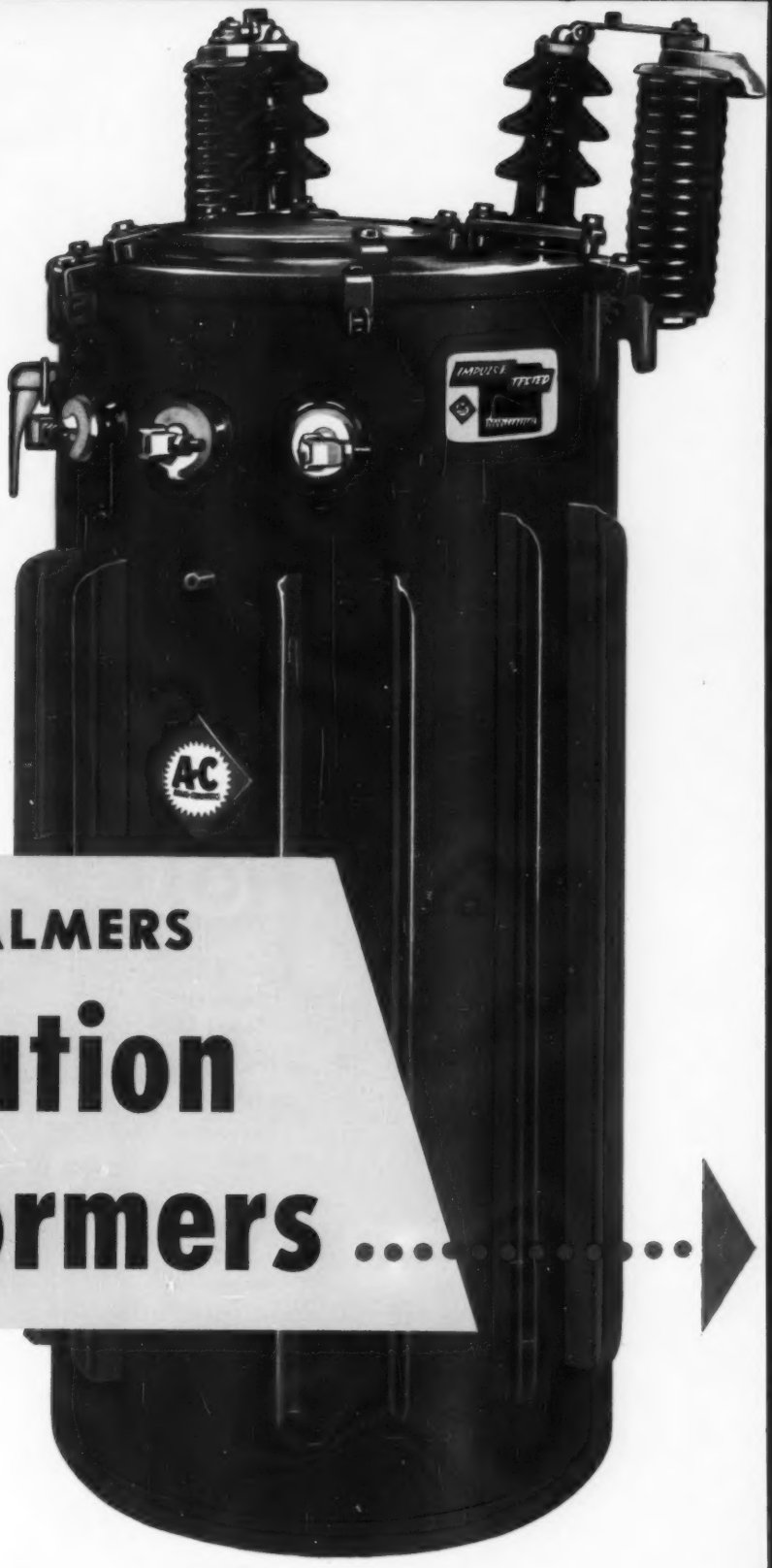
Channel Duct

Designed for complex wiring patterns, this channel duct is said to aid control panel assembly and wiring techniques, permit layout changes and simplify maintenance. Manufacturer claims resistance to warpage, dielectric strength and flame resistance.
Glastic Corp, Cleveland 21, Ohio

(*More New Equipment on page* 141)

YOU GET
MORE

Extra
Value
Features



IN ALLIS-CHALMERS

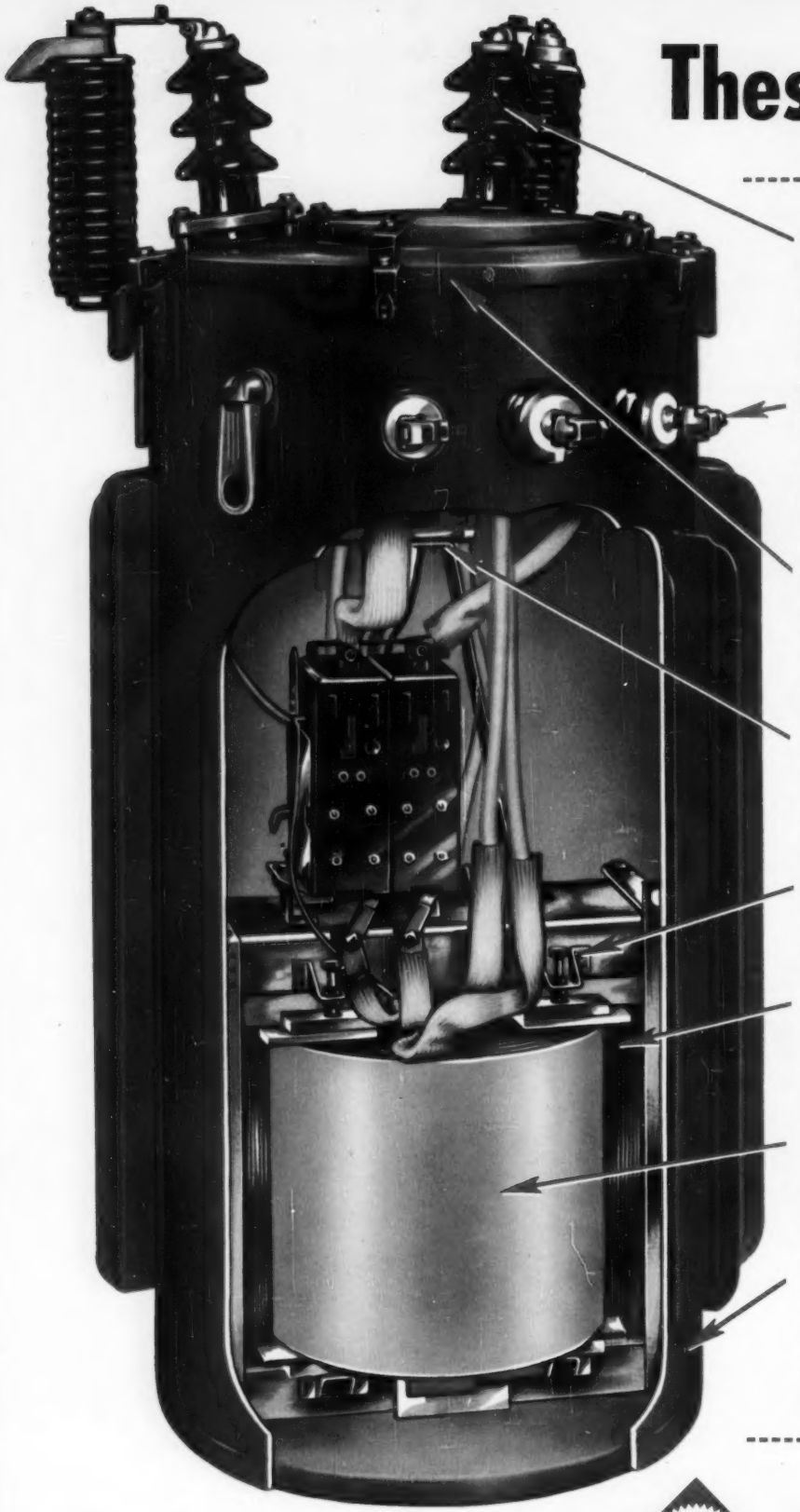
Distribution Transformers

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

A-5068

These Quality



Time-saving, easy-connecting high voltage bushing accommodates any EEI-NEMA conductor size. Bushing is radio-interference free. Terminal assembly keyed to porcelain to prevent gasket movement or shearing.

Double-keyed low voltage bushing gives positive protection against rotation, eliminates possibility of internal short circuit. Corprene gaskets are fully retained . . . are compressed without twist or shear. Tinned clamp-type connectors permit use of either copper or aluminum.

Precision-fitted, positive-seal cover is oil and air tight. Tank is effectively sealed with permanent type, fully retained gasket. Captive cover clamps save time, too — they can't fall to the ground during inspection or periodic maintenance.

Easy-to-read indicator plate marks tap-changer position. Operating handle and indicating plate are well above oil level. Porcelain base increases dielectric strength and tracking resistance.

Adjustable-type coil supports lock coil firmly and safely into position. Pads under support are specially compounded for strength, give even clamping over coil width.

Low losses . . . low exciting current . . . improved regulation with compact *Curvacore* construction. High quality, preferred oriented cold-rolled core steel is used. Core loops are carefully matched.

Oven-dried assembly insures low insulation power factor. Each coil is thoroughly dried and then tanked while still hot to prevent moisture penetration.

Machine-welded, heavy gauge sheet steel tank is made to be as maintenance-free as possible. Tank bottom is recessed with straight wall construction inside and out — no place for condensation or water to collect.

Curvacore is an Allis-Chalmers trademark.

A-C ALLIS CHALMERS

ALLIS-

Features Make Allis-Chalmers Your Best Transformer Buy

Controlled Quality Means MORE Transformer Value

Production checks assure quality throughout Allis-Chalmers distribution transformers. From the heart of the transformer — the core steel — to the bushing terminal cast connectors which receive a severe mercurous nitrate test, all component parts are carefully inspected and tested.

Mechanical inspection and electrical tests are conducted at various stations along the production line to maintain rigid engineering specifications.

Even the thickness of paint is measured under the Allis-Chalmers Quality Control Program. Exclusive hot-spray paint process insures long paint life with minimum maintenance.

Production line impulse testing is one of the final steps in Allis-Chalmers Quality Control. Regardless of size or voltage, every Allis-Chalmers distribution transformer brings you this seal of quality.

SEE FOR YOURSELF

All the features and advantages of Allis-Chalmers distribution transformers are graphically, conveniently explained with the Allis-Chalmers "Visualizer." Call your nearby A-C district office and ask to see it. Or write to Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for complete information.

CHALMERS

ALLIS-CHALMERS

NETWORK TRANSFORMERS

Space-Saving Solution To Network Problems

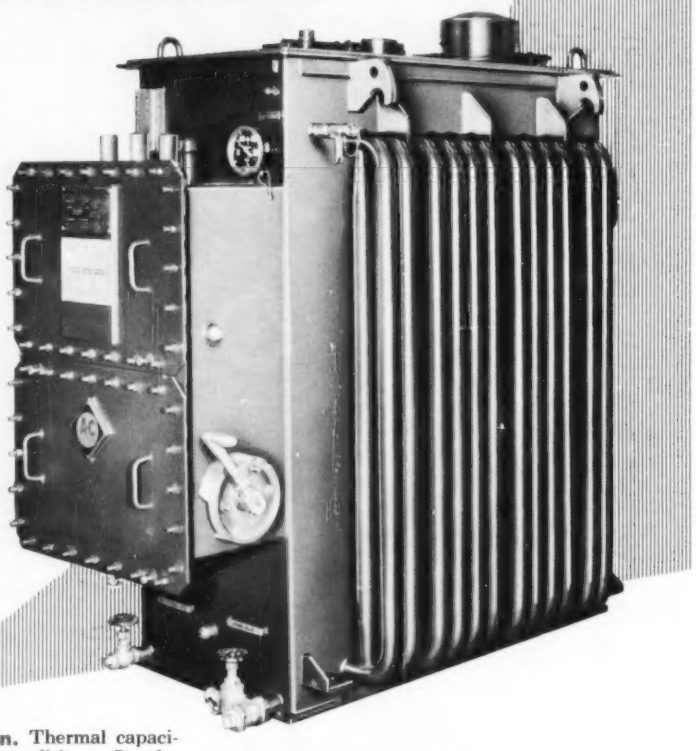
COMPACT design means savings in high-cost space when you use Allis-Chalmers network transformers. Utilities all over the country are choosing Allis-Chalmers as increasing loads put more demands on their downtown network systems. New Allis-Chalmers units are ordered repeatedly to take their place alongside the more than 1½ million kva already installed.

You get unusual flexibility in choice. To simplify application problems, Allis-Chalmers builds all three types: oil-filled, *Chlorextol* liquid-filled, and sealed dry-type.

Investigate all the advantages of compact, reliable Allis-Chalmers network transformer design. Consult your nearby A-C district office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

A-4781

Chlorextol is an Allis-Chalmers trademark.



Compact, low-loss design. Thermal capacities are high for severe load conditions. Sturdy, time-proved core and coil construction withstands repeated short-circuit stresses of network operation.

Safe, dependable tap-changing mechanism. Handle inserted through two-inch opening on cover operates mechanism. Handle cannot be removed unless it is in positive tap position. Cover location of handle entrance eliminates packing gland maintenance.

Threaded valve connections to tank are solder-wiped for extra protection. Valves are located for easy access. Globe-type valves with nonrotating seats close tight, avoid wear on valve seats.

Spiral-wound gaskets have proved their superiority over other types of gaskets for sealing bushings in the tank wall in over 7 years' continual use. Alternate plies of preformed spring-like metal and nonmetallic fillers provide unusual resilience and actually adjust themselves to changes in operating conditions. Gaskets can be installed without cements or grease. They can be quickly removed if required and may be re-used.

Shot blast cleaning, three coats of baked-on paint formulated for high water resistance, and protective compound treatment of base and tubes in base area give superior surface treatment.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

LIVE BETTER ELECTRICALLY

Manhole Condulets

Two styles of above-ground manhole condulets are said to provide simple, economical means for splicing main electrical feeder cables and making branch taps. The "GUB" (above) is described as explosion-proof, dust-tight and weather-resistant for use in hazardous areas. "WJH" is for ordinary locations.

Both styles handle up to 600 v when block-equipped. Without blocks, regular or shielded cable can be spliced for up to 5 kv. They are equipped with breathers and drains to reduce internal condensation.

Crouse-Hinds Co, Wolf & 7th N. Sts, Syracuse 1, N. Y.

100-Amp Fuse Puller Switch

Equipped with double load and neutral lugs, a 100-amp fuse puller switch, series TC37, is said to be suitable for service entrances, especially for rewiring jobs. Two sets of load lugs, rated 60 and 100 amp, permit connection of two loads when switch is used as a main disconnect. On new jobs, it serves as separate main disconnect to feed a lighting panelboard and a load center for unit kitchen or other groups of appliances.

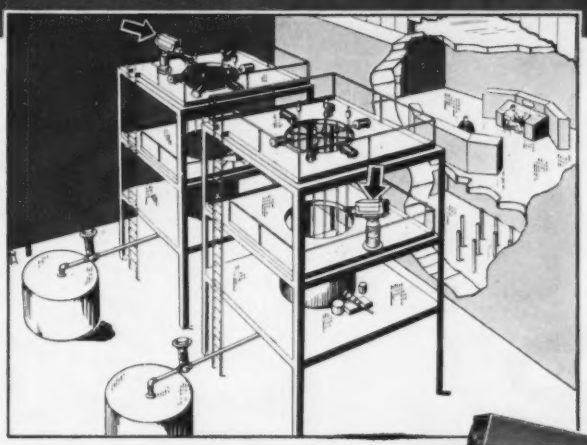
Rated for 120/240-v ac, single-phase, 3-wire service and 125/250-v dc service, the switch is available in general and raintight enclosures.

General Electric Co, Trumbull Components Dept, Plainville, Conn.

(*More New Equipment on page* 142)

Diamond "UtiliVue" (WIRED TELEVISION)

used in NUCLEAR REACTOR STUDIES at Battelle Memorial Institute



Arrows indicate remotely controlled "UtiliVue" Cameras that SEE experimental nuclear reactor cores.

"UtiliVue" pedestal enables camera to be rotated 320° and tilted 90° by remote control from console. Zoom lens (also controlled from console) brings objects into focus at widely varying distances from camera.

"UtiliVue" Monitor is built into control console in separate control room where experimental nuclear reactor cores can be WATCHED in perfect safety.

The "UtiliVue" is invaluable whenever there is the need for actually SEEING what is happening where it is impossible or impractical for the human eye to watch directly. There are installations of Diamond Industrial TV that have been in continuous operation since 1946. For further information, get in touch with your Graybar Distributor or use the coupon below.

7406

DIAMOND POWER SPECIALTY CORP.
"FIRST IN INDUSTRIAL TELEVISION"
ELECTRONICS DEPT., P.O. BOX 56AA
LANCASTER, OHIO

Please send me without obligation a copy of new bulletin showing how Diamond Industrial (Wired) Television will help me reduce costs, improve quality, increase sales and aid safety.

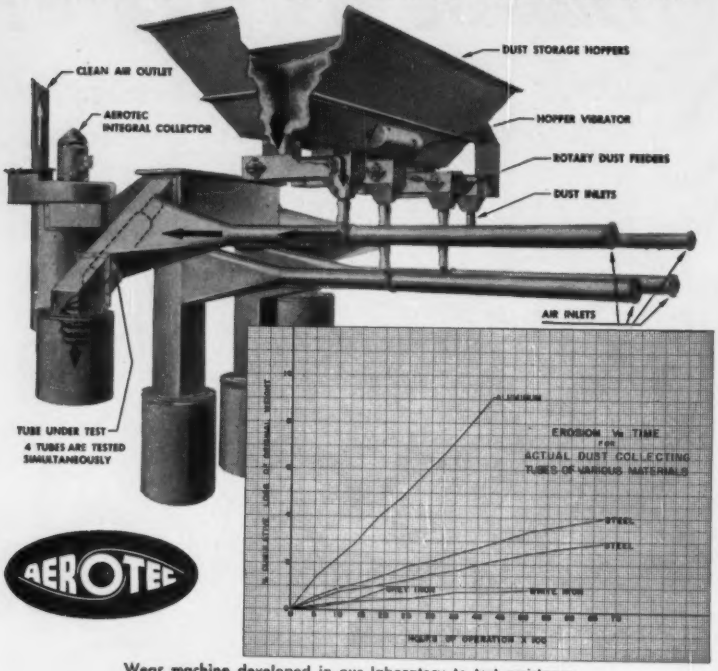
Name_____

Title_____

Company_____

Address_____

...PROVING EROSION RESISTANCE



AEROTEC

Wear machine developed in our laboratory to test resistance of various metal tubes. Above chart shows loss of weight in tubes of aluminum, steel, grey iron and white iron.

years of research by AEROTEC now assure *longer tube life* for mechanical dust collectors

Dust collector tubes of aluminum, because of the ductility of the metal, were at one time thought to be more erosion resistant than steel. However, *accelerated tests now prove conclusively that of all the basic metals tested, white cast iron tubes assure greatest resistance to abrasion.*

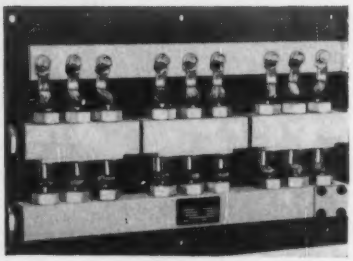
In setting up the test procedure, unusually severe abrasive conditions were simulated—many times more severe than ever encountered in field installations. The most troublesome dust erosion-wise was selected for the test. After 6700 hours of continuous operation, tube wear for various metals produced the curves shown on this page. Note the outstanding performance of the white iron tube. Although in many cases aluminum tubes are proving entirely satisfactory, white iron is now recommended for the majority of new installations.

In development for over three years, the new Aerotec 5" white iron tube will assure longer life and continuing high efficiency in your dust collection equipment. Why not call or write today for complete information? Address The Thermix Corporation, Project Engineers for Aerotec.

Project Engineers **THE THERMIX CORPORATION** Greenwich, Conn.
(Offices in 38 principal cities)
Canadian Affiliates: T. C. CHOWN, LTD., 1440 S. Catherine St. W., Montreal, Que.

Manufacturers
THE AEROTEC CORPORATION
Greenwich, Conn.

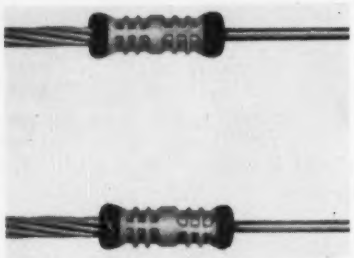
Designers and Manufacturers of Automatic Controls, Valves — Regulating, Relief, and Check Type; Pressure Switches; Gauge, Altitude, Differential and Absolute Types — Float Switches: Top, bottom or side mounted — Single, Dual or Tandem.



Germanium Rectifier

This 100-kw liquid-cooled germanium power rectifier is described as being capable of delivering 80-v dc at 1,350 amp with a maximum input of 66-v and about 1,150-amp ac, 3-phase, and with rectifier efficiencies to 98.4%.

Manufacturer recommends this 3-phase full-wave bridge rectifier for ac to dc conversion where high current at moderate voltage output and small unit size is required. Its design provides for cooling at 30 C max inlet and 4-gal/min flow rate for water.
International Rectifier Corp, 1521 E. Grand Ave, El Segundo, Calif.



Compression Sleeves

Made of aluminum alloy, a line of service entrance compression sleeves are ⅝ in. OD. They are designed to make use of ⅝-in. dies and tools now available. Seventeen sizes are said to accommodate combinations of aluminum, ACSR and copper conductors from No. 8 to 1/0 AWG.

Sleeves are marked to show die size, die press area, catalog number and cable size application. Features include an inhibitor for high conductivity, pull-out strength and compatibility with copper or aluminum, or combinations of each.
Anderson Electric Corp, P.O. Box 2151, Birmingham 1, Ala.

(*More New Equipment on page* 144)

Why be half safe?

Specify AUTO-SPEED interruption . . . 3E Air Interrupter Switches

Howard Shatzer, 3E field engineer, checking an Air Interrupter Switch before shipment.

What is **Auto-speed interruption** . . . an automatically produced interruption that always occurs at the same point in the switching operation, and always takes the same time (one-half cycle). Human error is eliminated from the switching action by a trigger spring mechanism which trips the switch at a pre-set point. Contacts are separated inside a dry type interrupter unit.

Specify safety for personnel and equipment. No exposed Arc. 3E Air Interrupter Switches will not produce external arcing dangerous to men or equipment.

Specify economy Costing less than circuit breakers and with interrupting capacity not found in air break disconnects, 3E Air Interrupters are ideal for . . . interrupting magnetizing charging current of transformers . . . interrupting charging current of lines and busses . . . interrupting exciting current of feeder regulators . . . interrupting load currents to rated capacity . . . sectionalizing feeders and distribution circuits.

Specify Engineering Ability 3E's staff of engineers is experienced in adapting or combining equipment for complete switching centers or additions to existing units. Designing for unusual needs . . . corrosive or dusty atmospheres, unique space requirements, portable units, or carefully calculating tomorrow's expansion requirements . . . we are geared to handle the unusual.

Howard Noble, 3E Sales Promotion Mgr., demonstrates Air Interrupters in a complete cubicle installation.

Write for Bulletin 152

3E Air Interrupter Switches are made in ratings up to 15 K.V.

ELECTRICAL ENGINEERS EQUIPMENT CO. Melrose Park, Illinois

Representatives in principal cities—in Canada by Power-Lite Devices, Ltd.

How high is up?

It feels like 20 stories to a lineman who is finishing his last connection, only to have a connector bolt snap, or the head break off. Small item? Try climbing down and hunting for a spare bolt or, worse yet, find it's a special bolt that you've got to order out.

You won't find these problems with Royal Connectors. Big ½ inch Silicon Bronze hex head bolts are standard on *all* Royal connectors from ½" IPS and larger, and 500 MCM and larger. Nested bolt heads permit "one-wrench" installation.

Insure the fastest, trouble-free installation and a lifetime of dependable service with Royal heavy-duty Power Connectors. And look for the "Royal Treatment" on delivery, too. Call Royal today!

ROYAL

part of the arsenal of AMERICAN POWER PRODUCTION

ROYAL ELECTRIC MANUFACTURING CO., INC.
1122 EAST 87TH STREET • CHICAGO 19, ILLINOIS
Designers and Manufacturers of Power Switching Equipment and Special Electrical Devices

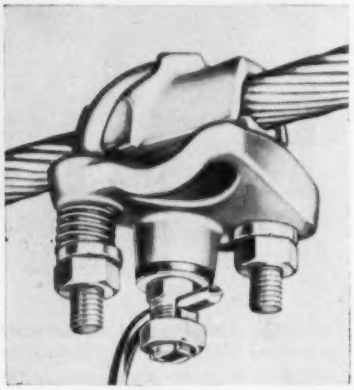
Reflective Labels

Die-cut numbers made of "Scotchlite" are designed for identification of transformers, poles and other utility equipment. The pre-cut labels are said to make identification possible at nighttime and in bright sunlight. Application of the emblem is rapid; varied color combinations indicate voltages and serial numbers; and a pressurized acrylic coating protects numbers for life of equipment, the manufacturer claims.

Emblem Tape & Label Co, 2308 15th St, Denver 2, Colo.

Hot Line Clamp

Called Swivelok, this hot line clamp for large aluminum mains is said to have advantages of U-bolt connections.



Castings and hardware are aluminum alloy. Clamp is available with tin plated bronze split-bolt or aluminum compression taps. Wire ranges: Main, 1/0 to 336.4 ACSR; Split-bolt, 6 to 2/0 AWG; Compression, 6 to 1/0 ACSR.

Jasper Blackburn Corp, 35 Madison St, St. Louis 6, Mo.

Distribution Panelboard

This power distribution panelboard, equipped with fusible switch units of quick-make, quick-break type, is designed for 600-v ac service, 2 or 3-wire, single-phase, and 3 or 4-wire, 3-phase applications.

Called Type QMR, it can be operated in systems having short-circuit

(*Continued on page* 146)

NOW!

3 new SCOTCHCAST BRAND kits for cable splicing!

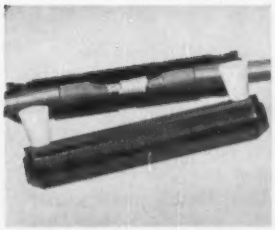
Reg. U.S. Pat. Off.

Here is everything you need to make a splice and insulate it on any single-conductor cable up to 600,000 CM . . . quickly, easily with "factory-tight" efficiency – and it's all in kit form!

The new "SCOTCHCAST" Brand 82-A1, A2 and A3 kits (for different sized straight-line splices) and 90-B1 kit (for wye and tap splices) utilize "SCOTCHCAST" Resin No. 4 in the famous ready-to-use "Unipak" container. "SCOTCHCAST" Resin effectively blocks all possible moisture entry points; gives you maximum insulation and protection against mechanical and electrical stresses on every splice.

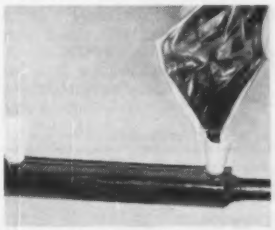
All materials for this revolutionary non-technical splicing method are included in the "SCOTCHCAST" kit. SEND FOR NEW FREE BOOKLET describing the "SCOTCHCAST" kits in detail. Just write on your letterhead to Minnesota Mining and Manufacturing Company, St. Paul 6, Minnesota, Dept. BV-76. Do it today!

Three easy steps...and a completed splice!

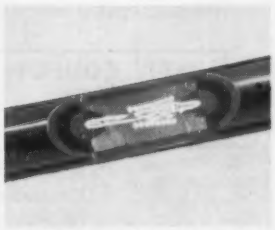


1 Cable is spliced and mold-halves are assembled over splice area. Kit contains all necessary materials.

2 Remove "Unipak" container from foil envelope; squeeze the bag to activate the "SCOTCHCAST" Resin.

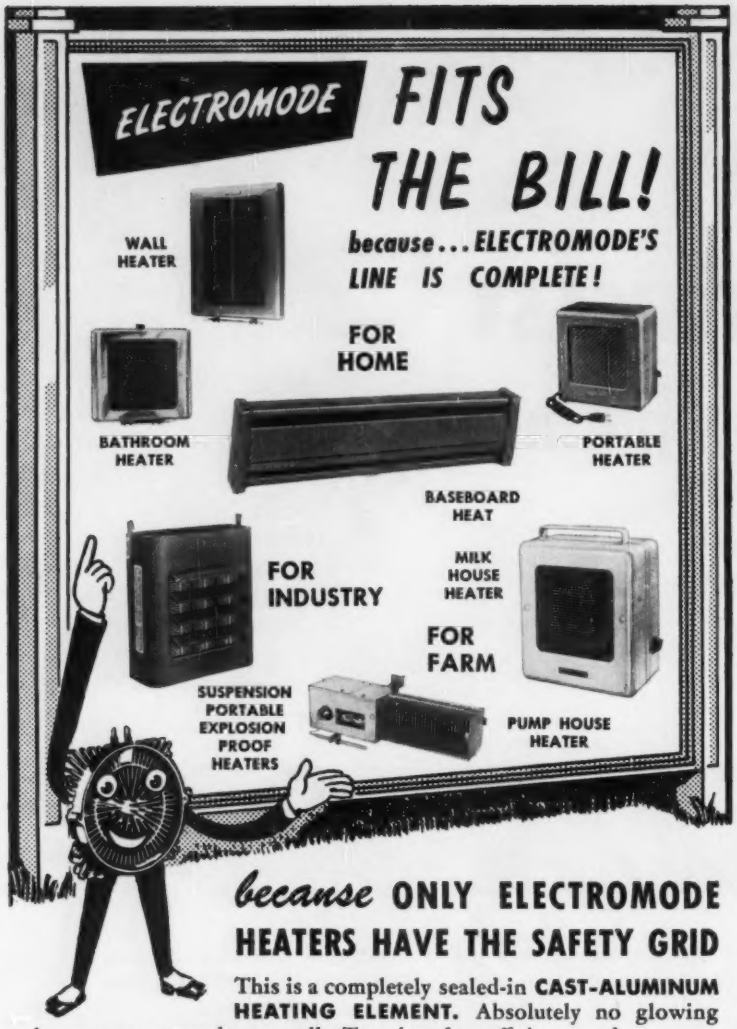


3 Pour activated "SCOTCHCAST" into mold, using pouring spouts supplied with kit. Resin begins to set immediately.



4 Cut-away photo shows how tightly splice is sealed – the "SCOTCHCAST" way – against any moisture penetration.

The term "SCOTCHCAST" is a registered trademark of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P. O. Box 757, London, Ontario.



because ONLY ELECTROMODE HEATERS HAVE THE SAFETY GRID

This is a completely sealed-in **CAST-ALUMINUM HEATING ELEMENT.** Absolutely no glowing elements or exposed open coils. Tops in safety, efficiency and economy. The Electromode heating element is guaranteed for five years.

because ELECTROMODE LEADS IN ELECTRIC HEATING

ELECTROMODE
Division Of
COMMERCIAL CONTROLS CORPORATION

For more than a quarter century Electromode has concentrated on one specific industry—heating by electricity. From the beginning Electromode has pioneered for a quality product and has continued to expand its line to include the most modern developments in electric heating equipment to serve present day needs. As a result of Electromode's firm stand on quality, complete satisfaction has been the rule with those who either sell, install or use Electromode electric heating equipment.

MAIL COUPON TODAY

MAIL COUPON! Please send your FREE Electric Heating File, containing specifications, illustrations, installations, prices and how to figure electric space heating.

ELECTROMODE Division
Commercial Controls Corporation
Dept. EW-76, 45 Crouch Street, Rochester 3, N. Y.

We are interested in ☐ Home ☐ Industrial ☐ Farm

Name.....

Address.....

City.....Zone.....State.....

Distribution Panelboard

(*Continued from page* 144)

capacities up to 100,000 amp RMS asymmetrical when current-limiting fuses are used. Ratings of 30 to 200 amp, 2 and 3-pole construction are available. Units are horsepower rated for standard and time-delay fuses.
General Electric Co, Plainville, Conn.

X-Ray Machine

This mobile x-ray machine is said to penetrate 6 in. of steel. Supply voltages are 220 and 440, 60 cycles. Interchangeable tube heads are available in 150kv/20ma capacities of either fine-focus or 360 deg radiation-beam emitting type.
Holger Andreasen, Inc, 703 Market St, San Francisco 3, Calif.

Electronic Tachometer

Featuring a package type plug-in assembly that permits quick replacement of any or all nine of its separate components, an electronic tachometer is serviceable by unskilled personnel.

Called Model ETC, it counts revolutions per minute, rate or frequency, by counting 10 to 50,000 electrical pulses per second for a timed interval.
Standard Electric Time Co, Springfield, Mass.

Front Truck Winch

A factory-mounted front winch, rated 6,000-lb nominal capacity, has been made available for manufacturer's light-duty, 4-wheel-drive truck. Cable capacity of the winch is 375 ft of ¼-in. or 270 ft of ⅜-in. cable.
International Harvester Co, 180 N. Michigan Ave, Chicago 1, Ill.

(*More New Products on page* 148)

New HOMELITE Pump

Whispers While It Works

Goodby residential complaints! Here's a new lightweight gasoline engine driven pump that takes it easy on the neighbors' ears. Yet handles any water problem . . . from seepage to volumn pumping! The new Homelite Model 36 S2 2″ self priming centrifugal Pump operates at slow speed with low noise level yet has high capacity of 9000 gallons per hour. It weighs only 85 pounds and can be easily carried by one man to the best pumping location. Starts quickly, primes automatically, gives long, dependable and trouble-free service under the toughest conditions. Ask your Homelite Representative for a free demonstration. You'll find a good neighbor policy in every pump.

HOMELITE

A DIVISION OF TEXTRON INCORPORATED

6107 RIVERDALE AVENUE • PORT CHESTER, N. Y.

Jersey Central Power & Light Co., South Amboy, N. J. Burns & Roe, Engineers.
The Cope Cable Trough shown above carries as much cable as all of adjacent system.

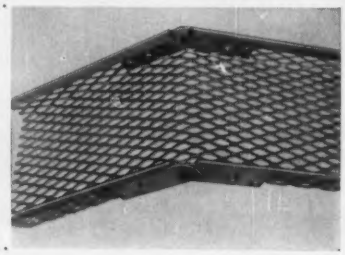
Jersey Central Power & Light Company Cuts Costs with Cable Trough

The great space saving possible with Cope Trough is dramatically illustrated at Jersey Central Power & Light Company's South Amboy installation of cable supports. Where space is at a premium, specify Cope Cable Trough.

SAVE LABOR during installation. Cope Cable Trough with the exclusive Pin-Type Coupler goes in faster than any other trough system. Standard fittings are available for virtually any connection, corner, awkward space—yet fewer individual pieces are needed and installation time is greatly reduced.

SAVE MATERIALS with Cope Cable Trough. You support far more cable with the same weight of Trough than with any competing system—and steel is costly.

Elevation changes are simple with Cope Trough. Edges of the Trough may be cut readily and standard fittings insure rigid support.



Our engineers are ready to work with you. Write us today for full details on new 70,000 Series.

T. J. COPE, INC.

COLLEGEVILLE 4, PENNSYLVANIA

Cope

GROUND TENTS

ROD GRAPPLES

CABLE REEL JACKS

WARNING SIGNS

CROSS ARM SHEAVES

MORE NEW PRODUCTS

Nuclonics Engineering Laboratories, Inc, 32 Monadnock Road, Wellesley Hills 81, Mass., has a potentiometer-type **dc voltmeter** with 10 overlapping ranges from 1 to 1,000 v. It measures and adjusts precision power supply output, determines regulated power supply regulation and stability, and calibrates dc instruments.

Mobile Aerial Towers, Inc, 1730 N. Harrison St, Ft. Wayne, Ind., offers a 6-ft, 6-in., noiseless hydraulic **pruning tool** adaptable to its Hi-Ranger extensible personnel platforms. It cuts branches up to 2-in. diam, weighs 11 lb.

Wac Engineering Co, 35 St Clair St, Dayton 2, Ohio, has a **tachometer** for integral horsepower and automatic machinery. Called "Wac-Tac," it delivers an ac voltage whose frequency and magnitude are linear with speed.

Diehl Mfg Co, Finderne Plant, Somerville, N. J., offers a flat-type radial-design **motor** ranging from ⅓ to 7½ hp for industrial equipment where space is limited. Operates at 208, 220/240 or 550 v, 2 or 3 phase at 60 cycles.

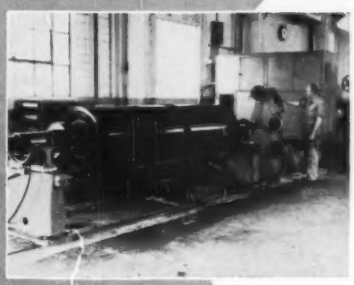
Federal Telephone & Radio Co, 100 Kingsland Road, Clifton, N. J., has a **VHF field strength indicator** covering a range of frequencies from 47 to 225 mc. It is portable, can be operated from dry batteries or standard ac line.

Metropolitan Wire Goods Corp, 70 Washington St, Brooklyn 1, N. Y., offers steel rod **shelving** that is assembled without nuts, bolts or screws. It features quick assembly and heavy capacity.

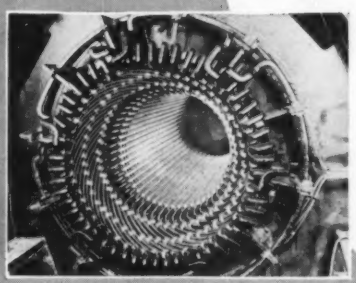
Square D Co, 6060 Rivard St, Detroit 11, Mich., has **card holder** kits that provide legible identification of electrical circuits, panelboards, switches and load centers.

Guardian Electric Mfg Co, 1621 W. Walnut St, Chicago 12, Ill., offers an 11-oz, 25-amp **power relay** with contacts rated continuous duty, 230 v ac with 75% load factor. Standard unit is double pole, double throw.

(*More New Products on page* 153)



A rotor being dynamically balanced to close tolerances after rewinding to insure vibration-free operation.



A completed stator winding (Note special end turn tying and bracing).

CALL NATIONAL FOR FAST SERVICE AND TOP QUALITY ON REWINDING INDUSTRIAL TURBO GENERATORS

Fast service. Top quality for longer service life. Modernization for improved performance. You can count on these when you call on National for rewinding of your turbo generators.

The National shops are completely equipped and manned for the performance of all winding operations. When size or distance makes it impractical to ship the machine to us, we do the work on the spot. For complete details, just call your nearby National field engineer or drop us a line.

NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

TRADE MARK

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

Need Alum Cable

Long before many wire and cable users ever considered aluminum, the white metal became an active part of Anaconda's plans for the future. As a result, Anaconda is the only manufacturer in the industry today who is prime producer and fabricator of *both copper and aluminum.*

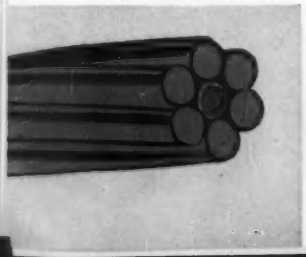
Now, when you may be thinking seriously of aluminum for the first time, or of increasing your percentage of aluminum purchases – Anaconda offers you this:

1. *Broadest line of aluminum conductors in the industry* including bare aluminum and ACSR; Neoline*, Polene* and Duraline* line wire; Types SE, SD, N-SD and K service cables; aerial power cable; network cable; cathodic protection cable; and many others.

2. *Seven-mill service.* Anaconda has more mills producing aluminum wire and cable than any other manufacturer. Seven fabricating mills strategically located across the country assure speedy service.

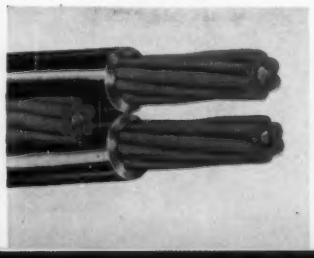
3. *Electrical Distributors.* Anaconda Wire & Cable Company has several hundred electrical distributors located throughout the country who can expeditiously provide you with Anaconda products.

ACSR

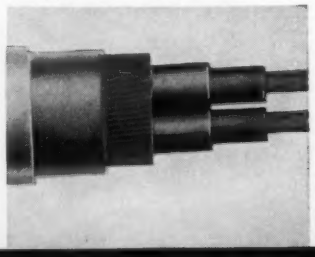


Bare strand aluminum

Type N-SD



Silvaline*
Type SE service entrance



more inum ?

ANACONDA IS READY WITH THE BROADEST LINE IN THE INDUSTRY

4. *Reduction plant* at Columbia Falls, Montana, gives Anaconda control over its aluminum production from reduction of alumina . . . to wirebar . . . to rod . . . to finished product.

5. *Insulated-cable experience* – in design, research, construction and quality control – helps Anaconda produce aluminum wire and cable with superior electrical and physical characteristics.

6. *Technical assistance.* Anaconda field engineers have worked in advisory capacity on hundreds of complex jobs. They are ready to put their experience and knowledge to work on your problem.

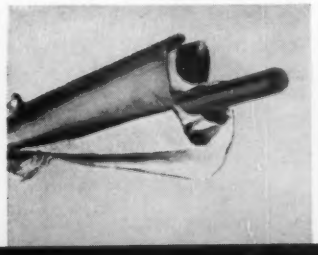
The Man from Anaconda will be happy to help you. Backed by the broadest line of wire and cable in the industry in both copper and aluminum, he is best qualified to help you arrive at the most practical and economical answer to your cable needs. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

*Reg. U. S. Pat. Off. 56001

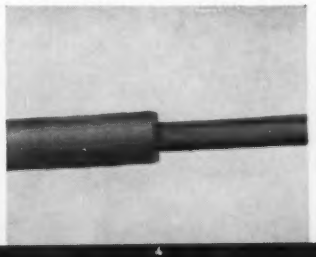
ASK THE MAN FROM ANACONDA®

FOR ALUMINUM WIRE & CABLE

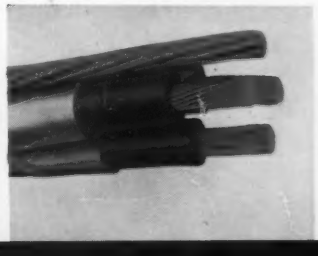
Duraline*



Neoline* and polyethylene line wire

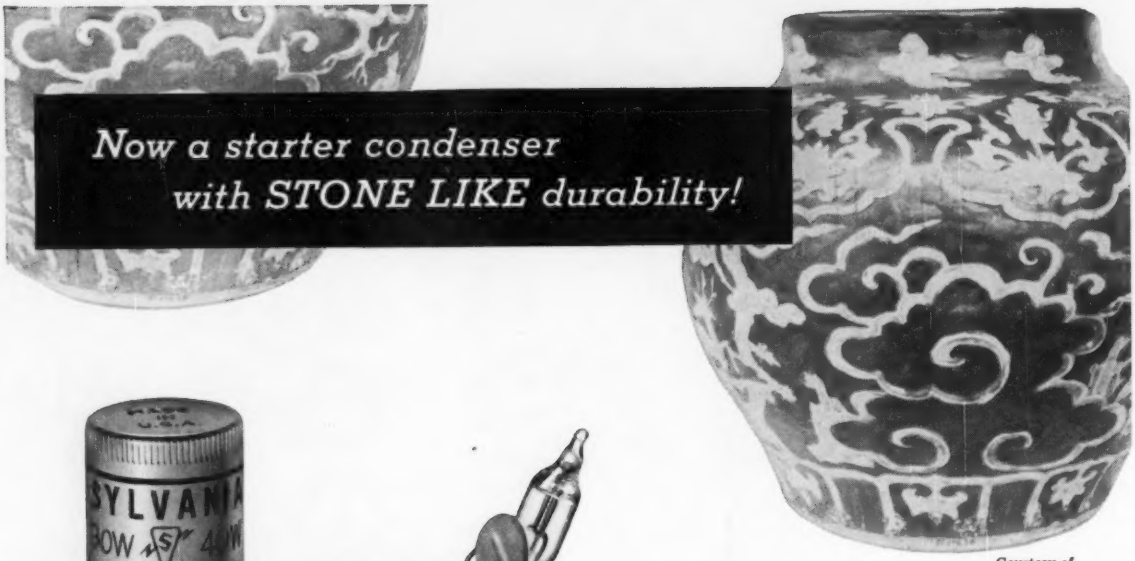


Aerial cable



Type CP cathodic protection cable

Now a starter condenser with STONE LIKE durability!



Courtesy of Metropolitan Museum of Art

Sylvania's new ceramic condenser and the 500-year-old vase shown above are made from practically identical materials that defy deterioration.

Sylvania's new CERAMIC starter condenser

triumphs over heat, cold, moisture... out-performs all others!

Sylvania's new ceramic condenser conquers the main causes of starter failure. Its stonelike durability is practically impervious to the effects of heat, cold, and moisture which occur inside the starter shell.

Unlike ordinary wax-filled paper condensers which break down from globottle heat as low as 148°F, Sylvania's ceramic condenser is unaffected by temperatures up to 500°F. It cannot absorb moisture caused by condensation which causes paper condensers to fail.

The new ceramic condenser is now available in FS-4, FS-12, and all 100-watt Sylvania Fluorescent Lamp Starters.

Learn how you can save time and dollars. When you buy fluorescent starters be sure to ask for SYLVANIA—the practically indestructible starters with *ceramic* condensers. For complete information call your Sylvania Supplier, or write:

SYLVANIA ELECTRIC PRODUCTS INC., Lighting Division
60 Boston Street, Salem, Mass.
In Canada: Sylvania Electric Products Inc. (Canada) Ltd., University Tower Building, Montreal

SYLVANIA®

... fastest growing name in sight

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

More New Products

(*Continued from page* 148)

Kinney Mfg Division, New York Air Brake Co, Boston, Mass., offers a two-stage mechanical booster high **vacuum pump.** Device is driven through a flexible coupling by 2-hp, 3,600-rpm, 3-phase, 60-cycle, 220-v motor backed by air-cooled compound pump coupled to 1-hp, 640 rpm gear motor.

Computer Control Co, Inc, Wellesley, Mass., offers spirally-cut tubing of **insulating plastic** called Spirap. It is said to wrap wire bundles up to 2-in. diam quickly.

Emerson & Cuming, Inc, 869 Washington St, Canton, Mass., says its **epoxide casting resin,** called Stycast 2662, can be used at temperatures to 600 F, pours readily and cures at low temperature.

CATALOGS—BULLETINS

• **RECORDERS:** Specifications, ranges and dimensions of a line of indicators, recorders, and recording controllers are given in Bulletin No. GEC-1362A, 2 pages. General Electric Co, Schenectady 5, N. Y.

• **ELECTRONIC INSTRUMENTS, PARTS:** Catalog "O," 258 pages, lists and illustrates line of electronic instruments and parts, gives charts and tables. Make requests on company letterhead. General Radio Co, 275 Massachusetts Ave, Cambridge 39, Mass.

• **EXPLOSION-PROOF MOTORS:** Bulletin GEA-6341, 8 pages, includes design features and maintenance of induction motors, 1 through 30 hp, for use in hazardous locations. General Electric Co, Schenectady 5, N. Y.

• **GYMNASIUM LIGHTING:** "How to" booklet on gymnasium lighting offers simplified procedure, selector chart and illustrations of equipment, 12 pages. Pittsburgh Reflector Co, 408 Oliver Bldg, Pittsburgh 22, Pa.

• **MICROWAVE:** Bulletin PC-6527, 16 pages, contains photos and diagrams of microwave installations and describes typical expandable systems for 500, 120 and 90 miles. Philco Corp, Govt & Industrial Div, 4700 Wissachickon Ave, Philadelphia 44, Pa.

• **ELECTRIC FURNACES:** Features, applications and cross section diagrams are included in bulletins on car-bottom furnaces (GEA-4068A, 4 pages) and rotary-hearth furnaces (GEA-4073A, four pages). General Electric Co, Schenectady 5, N. Y.

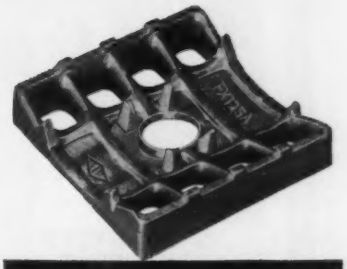
(*More Catalogs on page* 154)

M|F

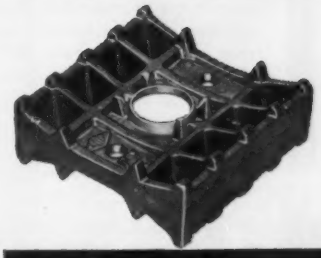
malleable iron

HIGH CORROSION RESISTANT

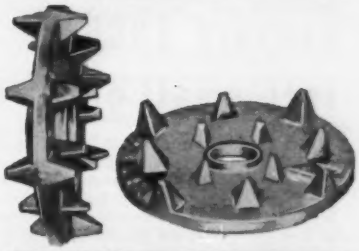
GRID GAINS and TIMBER CONNECTORS



GRID GAIN



DOUBLE GRID GAIN



TIMBER CONNECTORS

Improve stability and increase ultimate load by providing maximum contact for round wood member connections. M.I.F. Grid Gains and Timber Connectors require no special tools for installation.

- **Increase bearing value of the thru-bolt and shear value of the connection.**
- **Minimize bolt slotting.**
- **End need for pole framing.**
- **Reduce replacement requirements.**
- **Reduce possibility of decay by eliminating wood to wood contact.**
- **Offer many new opportunities to designers in the framing of both complex and simple structures.**

Write for Bulletin PH 10

MALLEABLE IRON FITTINGS COMPANY

POLE HARDWARE DIVISION

Branford, Connecticut

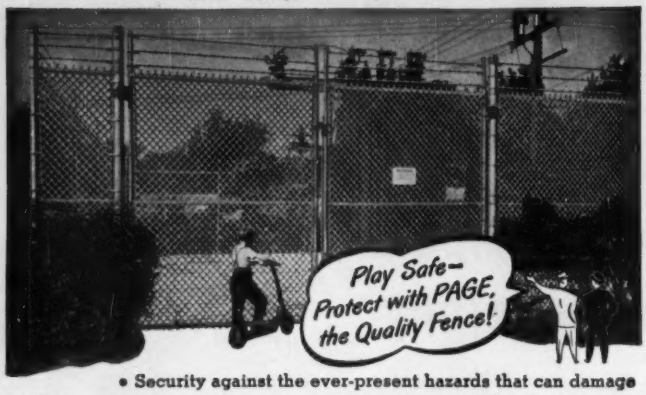
M|F

Representatives: William J. Cottrell Co., Portland, Ore. • James H. Drew Corp., Indianapolis, Ind. • Industrial Engr. & Equip. Corp., Los Angeles, Cal. • JSG Electric Co., Chicago, Ill. • Lee-Smith Co., Miami, Fla. • B. H. McCoin, Knoxville, Tenn. • William J. O'Brien, Memphis, Tenn. • Robert P. Smith & Co., Jacksonville, Fla. • E. A. Thornwell, Inc., Atlanta, Ga. • J. P. Voight, Summerville, S. C. • Waltham, DeWitt & Krusi, San Francisco, Cal. • L. G. Wendegatz, Kansas City, Mo. • Williamson Sales Co., Shreveport and New Orleans, La.; Dallas, Houston, Tex.; Pine Bluff, Ark. • O. C. Witte Co., Detroit, Mich.

In Canada: Line & Cable Accessories, Ltd., Toronto

PAGE chain link FENCE

America's First Wire Fence—since 1883



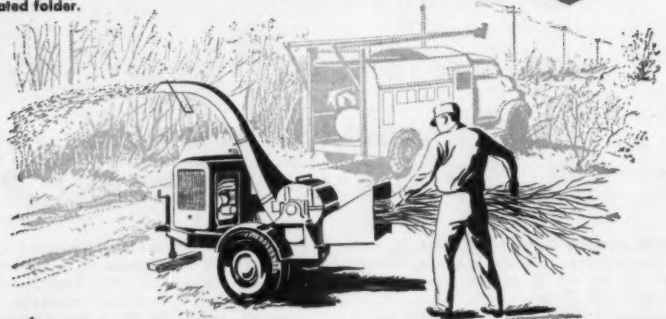
• Security against the ever-present hazards that can damage or destroy property, or injure persons, is a responsibility to assign to PAGE Fence. Whether you choose heavily galvanized Copper-Bearing Steel, corrosion-resisting Aluminum, or long-lasting Stainless Steel, PAGE Fence is quality controlled from raw metal to rugged fence erected on metal posts deep-set in concrete. Available are 8 basic styles, varied by heights, types of gates, top rails, and barbed wire strands for added security. Finally, your PAGE Fence will be expertly erected by a reliable, technically trained firm. For important fence data and name of nearest PAGE firm—

Write to PAGE FENCE ASSOCIATION in Monessen, Pa., Atlanta, Bridgeport, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia or San Francisco.

M & M BRUSH CHIPPERS

convert 3000 lbs. tree trimmings into small chips in 1 hour

A portable, highly efficient unit with its own power plant, the M & M Brush Chipper converts a truckload of useless brush into a small pile of chips in 21 minutes. The chips make excellent fuel, and can also be used for livestock bedding or mulch. The M & M Brush Grinder will handle branches (green or dry) up to six inches in diameter, and will deposit them in a truck or container or in a neat pile on the ground. The M & M Brush Grinder has a standard trailer hitch for towing behind car, jeep, or truck, and a retractable wheeled jack for levelling when detached from towing vehicle. Moving parts are fully enclosed for safety, and the whole unit is ruggedly constructed for long, hard service. Write today for illustrated folder.



MITTS & MERRILL 1002 South Water Street • SAGINAW, MICHIGAN

94

Catalogs—Bulletins

(*Continued from page* 153)

• **B-B TRANSFORMERS:** Bucking or boosting voltage, connection diagrams, kva ratings are given in Bulletin GED-2506A, on dry-type B-B transformers and autotransformers, 12 pages. General Electric Co, Schenectady 5, N. Y.

• **STEEL CASTINGS:** A 40-page manual, "Recommended practice for the welding of steel castings," supplies background on methods, preparation, effects, and operation of welding. It also describes procedures for carbon-steel and low-alloy steel castings. Trade names and manufacturers for all classes of electrodes are included. Tempil° Corp, 132 W. 22nd St, New York 11, N. Y.

• **GENERATING PLANTS:** Details on separate series of 1 and 2-cyl air-cooled, 4, 6 and 8-cyl water-cooled, and air-cooled diesel models are described in electric plant Catalog A-428 on complete line of manufacturer's generating plants; 8 pages. D. W. Onan & Sons, Inc, Minneapolis 14, Minn.

• **NETWORK TRANSFORMERS:** Operating features of manufacturer's oil and "Chlorextol" liquid-filled and sealed dry-type transformers are described in Bulletin 61B6152B. It includes electrical assembly of the units, tap changer and tank design, construction details and mechanism. Allis-Chalmers Mfg Co, 932 S. 70th St, Milwaukee, Wis.

• **WELDING:** 170-page Welding Data Book features welding procedures for every base metal. It covers 120 welding rods, electrodes and welding compounds. Eutectic Welding Alloys Corp, 40-70 172nd St, Flushing 58, N. Y.

• **POLYMER LUBRICANTS:** Three booklets on polymer lubricants, sealants and fluids include: Technical Bulletin 1-1-55, 6-pages, giving physical, electrical, chemical and mechanical properties; "Application Techniques for KEL-F Dispersions," 18 pages; and "KEL-F Fluorocarbon Oils, Waxes, Greases," 18 pages. M. W. Kellogg Co, Chemical Manufacturing Division, Box 469, Jersey City 3, N. J.

• **TURBINE GENERATORS:** Bulletin 1960C-P, 35 pages, includes types and applications, construction, testing and lubrication, sole plates, design features and lagging of turbine generators from 1,500 kw to 15,000 kw. Worthington Corp, Harrison, N. J.

• **TUBING:** Bulletin TDC-142A, 4 pages, gives data on mechanical and physical properties of seamless and welded carbon steel pressure tubing. Tubular Products Division of Babcock & Wilcox Co, Beaver Falls, Pa.

• **WELDING EQUIPMENT:** Types of welding equipment, electrodes, and accessories are listed in Bulletin GEC-1033, a 20-page buyer's guide. Included are ac and dc general purpose and industrial welders, semi-automatic and automatic equipment, and carbon block brazing equipment. Ratings, dimensions, and specifications are given as well as description and analysis for electrodes. General Electric Co, Schenectady 5, N. Y.

TOPFLIGHT
OPENINGS FOR

8

TOPFLIGHT
ENGINEERS

Hubbard and Company, world's largest manufacturer of pole line hardware and electrical protective equipment, is in the midst of an expansion program that creates excellent opportunities for eight topflight engineers.

Hubbard plants at Pittsburgh, Chicago, and Oakland have been enlarged and improved and a new plant is under construction at Plano, Texas. This expansion is necessary to keep up with the growth of the electrical utility industry and the communications industry, which Hubbard and Company serves.

Hubbard's Electrical Materials Division has openings for specialists in lightning arresters, fuse cutouts, and other current-carrying electrical protective devices.

There are also openings for street lighting engineers to help meet the growing demands for aluminum street lighting standards and for aluminum and steel brackets.

Salaries and working conditions are good. Some traveling will be required. For the men we want, this is an opportunity for an excellent future.

If interested, please write to Richard G. Robbins, Vice President. Your inquiry will be held in confidence.

HUBBARD AND COMPANY
6301 Butler Street, Pittsburgh 1, Pa.

TECHNICAL LITERATURE

NEMA: Publications available from National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y., are:

- CB 1-1956, "American Standard Requirements for Brushes for Electrical Machines," covers carbon, carbon-graphite, electrographitic, graphite and metal-graphite brushes. Price $2.
- HE 1-1956, "NEMA Manual for Electric House Heating," contains insulation recommendations, a standard heat loss computing method, a method of selecting proper sizes of equipment, and a formula for estimating annual operating costs for installations. Price 25¢.
- MI 1-1956, "NEMA Standards Publication for Mining and Industrial Locomotives," provides a general description of trolley-type and storage battery, and combination-type mining and industrial locomotives, their motors, control, construction and weights of components. Price $1.75.
- ASA-NEMA have approved these magnet wire publications: "Single and Heavy Vinyl Acetal-Coated Round Copper Magnet Wire" (NEMA MW 15-1955, 75¢); "Heavy Vinyl Acetal-Coated Rectangular and Square Copper Magnet Wire" (NEMA MW 18-1955, 50¢; and "Double-Paper Single-Cotton Covered Rectangular and Square Copper Magnet Wire" (NEMA MW 32-1955, 50¢).

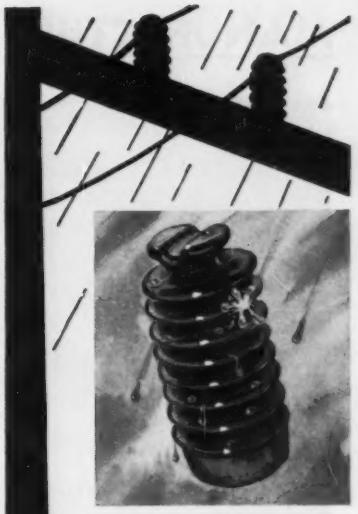
ENGINEERING CAREERS: National Society of Professional Engineers has compiled criteria of employment practices for the guidance of professional engineers and their employers. The booklet's principles and questions suggest responsibilities of employer to his professional employees, and the latter's responsibilities to employer; 16 pages.

STEAM TABLES A 5-page booklet on new steam tables covers a range from 5,500 psia and 32 to 1,600 F for power systems calculations. Authored by R. C. Spencer, General Electric Co; C. A. Meyer, Westinghouse Electronic Corp; and R. D. Baird, Allis-Chalmers Mfg Co, the tables are based on extensions of the Keenan and Keyes tables. American Society of Mechanical Engineers, 29 W. 39th St, New York 18, N. Y.

AUTOMATION: American Society of Tool Engineers, 10700 Puritan, Detroit 38, Mich., has published a 12-page brochure called "Automation—What's Ahead?" It summarizes a recent ASTE survey on effects and future of automation. Complimentary copy available to the executive officer when requested on company letterhead; additional copies, $5.

PLASTIC PIPE: National Sanitation Foundation, School of Public Health, Univ. of Michigan, Ann Arbor, Mich., has published a 94-page study of plastic pipe for potable water supplies. Tests included toxicological aspects, organoleptic study and air, water and soil contact effects. Price $1.

MACHINE TOOL STANDARDS: Revised "Machine Tool Electrical Standards" provides distinctions between mandatory and recommended practices, treats subjects like motor and circuit protection, control circuits and circuit enclosures, and specifications for conductors; 44 pages. National Machine Tool Builders Association, 2071 E. 102nd St, Cleveland, Ohio.

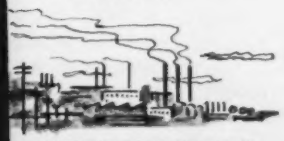


REDUCE INSULATOR LEAKAGE with DOW CORNING 5 COMPOUND

This silicone dielectric coating for insulators *reduces electrical leakage to a new, bare minimum* by preventing the formation of continuous, conductive moisture films. What's more, the silicone compound is unaffected by airborne contaminants such as fly ash, cement dust or earth particles.

Also a highly effective lubricant for switches, meters, condensers and similar mechanisms, *Dow Corning 5 Compound* won't stiffen, ice up, bleed or crack at temperatures ranging from -70 to over 300°F.

Once spread on, greaselike *Dow Corning 5 Compound* gives extraordinary protection that lasts without maintenance for many years. It resists moisture, oxidation, salt spray, fungi or chemical attack.



***FREE SAMPLE** and recent article describing Detroit Edison experience with Dow Corning 5 on request.*

Address
Dept. 4407C

DOW CORNING CORPORATION
Midland, Michigan

Kennecott Copper's Casting Wheel Provides . . .

New 'Cake,' Billet Shapes

The 500-ton vertical casting wheel above is Kennecott Copper Corp's answer to copper fabricators' desire for bigger "cakes" and billets. The king sized output of the company's Garfield, Utah, plant will enable fabricators to produce long sections of continuous rolled or strip copper and foil.

The wheel began spinning, albeit at moderate rpm, recently. It has three operation features that find Kennecott spokesmen claiming the device as a "first": **1.** By mounting both billet and cake molds on the wheel, a mold changing step is saved; **2.** total of 28 cake and 28 billet molds gives a present capacity of 40 tons an hour; and **3.** a 25-ft cooling chamber, linked to the wheel by a conveyor, cools the hot metal in quick time.

Said L. F. Pett, division general manager: "While the wheel is equipped to handle cakes up to 4,000 lb, we haven't, as yet, poured that size in regular production runs." Billets of 3 to 4-in. diam and 105 lb will be produced within a few months. Eventually billet size will reach 9 in. or more and weigh up to 1,000 lb.

Kennecott has invested $2 million in the device, supplementing a $17 million cost for the plant's casting facilities which heretofore had produced copper ingots, slabs and wire bars. New cake and billet sizes are sold to fabricators who produce wire, bus and other industrial products.

The cooling cycle for the cakes includes circulation of water through the mold walls while wheel is rotating. As the wheel stops to fill new molds, partially cooled cakes, right, are lowered from the mold by an elevator-ejector mechanism, eased onto a conveyor by an automatic arm system, and then passed through the spray chamber. The sequence from wheel to spray chamber to chipping to inspection is geared to the mold filling schedule.

Two electric arc furnaces produce the 2,150 F molten copper. The metal flows about 55 ft through a trough to the 4-ton ladle. Molten copper pours into one end of the ladle and out the other to fill two molds simultaneously.

In the middle of the wheel, an operator controls the ladling in a matter of about 3½ min. He is protected by an insulated cage. The wheel rotates about a substantial shaft and is powered by a heavy-duty hydraulic motor.

According to Pett, the device is important to the economy of domestic copper production on two counts: (1) The company can better serve its customers' needs, and (2) have a more economic distribution of the product to mid-west and western fabricators.

Delta-Star Presents Compact Control Switch

Delta-Star Electric Division of H. K. Porter Co, Inc, Chicago, has developed a type M-2 control switch that features compactness, simplicity and high interrupting capacity.

These switches are available in several types for operations such as circuit breaker control, motor control, manual-to-automatic selector, meter reading and transfer operations.

Assembled in sections with standardized parts, the switches are about 3⅞-in. high by 3¼-in. wide. They are reported to have a 20-amp continuous rating with a 250-amp, short-time (3-sec) rating. I-C ratings are: At 250 v ac on inductive circuits, single-break contacts 25 amp, double-break contacts 75 amp.

I-T-E Creates Sales Posts for Utilities, Distributors

I-T-E Circuit Breaker Co, Philadelphia, has created two new posts in its organization, Leo H. Lipscomb, vice president-sales, advises.

Appointments are:

Robert D. Cleaves, manager of utility sales—He will coordinate the company's sales program as it pertains to utility activities.

Hugh P. Maxwell, manager of distributor sales—He will coordinate I-T-E distributor sales program as in the past, but responsibilities are broadened by reason of acceleration of company activities in sales through distributors.

Sylvania's Data Center

Sylvania Electric Products, Inc, has placed in operation a nationwide 18,000-mile private communication network and a data processing system. (EW, Feb. 14, 1955, p. 51). The Western Union network links 71 stations in 61 cities and towns in 20 states. In Camillus, N. Y., (near Syracuse) is located the 50,000-sq ft data processing center with Remington Rand Univac electronic computer.

(*More M & M on page* 158)

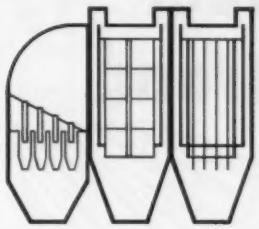
The industry's most experienced organization in dust, fume and fly ash recovery

—as near as your telephone!

Because the Western Precipitation Corporation stands alone in its years of continuous leadership in the complex science of recovering suspensions from industrial gases, Western Precipitation installations, quite naturally, are recognized throughout the world as the best obtainable. . .

■ Almost a half-century ago—in 1907 to be exact—Western Precipitation installed the first commercial application of the now-famous Cottrell Electrical Precipitator—and has more know-how, more varied experience and application background in world-wide installations in this type of equipment than any other organization, domestic or foreign.

■ Many years ago Western Precipitation was first again with the multiple small-diameter tube type of cyclonic collector—the type with higher centrifugal forces for greater recovery efficiencies. And through the years, Western Precipitation engineers have continuously led in new advancements, new refinements in the *mechanical* recovery field as well as in *electrical* recovery methods.



■ Western Precipitation was the first to combine Electrical and Mechanical recovery advantages in one compact, coordinated system—the CMP (Combination Multiclone—Precipitator) Unit. This equipment, offering almost constant collection efficiency despite varying gas volume, requires years of experience in both electrical and mechanical recovery methods for proper operating "balance".

. . . only Western Precipitation has had such extensive experience in basic recovery methods!

These are only a few of the many important reasons why a Western Precipitation installation is recognized as the best obtainable. This unequalled know-how is quickly available throughout the major industrial areas of the United States and Canada from strategically-located, fully-staffed offices and field representatives, as shown at right. There's one as near as your telephone.

So before you finalize any dust, fume or fly ash recovery plans, be sure to find out the vital *extra* advantages offered by Western Precipitation Corporation!

For literature describing Western Precipitation's unique background of experience and advancements, phone, wire or write our nearest office.

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Reverse-Jet Filters
HOLO-FLITE Processors

Western Precipitation Corporation

Designers and Manufacturers of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

Main Offices: **1004 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA**

Chrysler Building, New York 17 • 1 North La Salle Street Building, Chicago 2 • Oliver Building, Pittsburgh 22 • 3252 Peachtree Road N. E., Atlanta 5 • Hobart Building, San Francisco 4

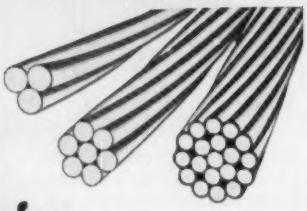
Precipitation Company of Canada Ltd., Dominion Square Building, Montreal

Representatives in all principal cities

ACCO Quality

PAGE

Stainless Steel Strand



for Severe Service Conditions

PAGE Stainless Steel Strand is equally versatile for ground, guy and catenary applications. Its higher tensile strength, corrosion-and-abrasion resistance, elastic limit and strength-to-weight ratio make it your first choice! Its lower cost per year of use means long-range economy.

Write us at Monessen, Pa., for complete information

ACCO

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Bridgeport, Conn.

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

for Better Value

'Super-Alloy' for 1,200F, Revealed by Westinghouse, Snubs Vibration

An alloy "predesigned" for use in high-temperature blades may permit increasing turbine operating temperatures up to 1,200 F and reduce blade vibration. This was announced last week in New York by scientists of Westinghouse Research Laboratory.

Known as Nivco, the alloy will probably get its first application in a 325-Mw, super-pressure turbogenerator being built at the company's Philadelphia, Pa., steam division.

Dr Clarence Zener, acting director of Westinghouse research, and Dr A. W. Cochardt, advisory metallurgist at the Pittsburgh laboratories, described the alloy as the first practical result of a new research technique for "predesigning" metals of the future.

Nivco is basically a cobalt-nickel steel, Dr Cochardt said, and includes smaller amounts of five other elements. Its ultimate tensile strength is about 100,000 psi at 1,200 F, he said. The alloy is prepared by melting in a vacuum furnace under an inert atmosphere of argon gas. After melting, it is treated and forged at 2,000 F. At 1,200 F, Nivco has five times the strength of 12% chrome steel, and a damping nearly equal to chrome steel at 900 deg, he said.

Described as an austenetic material, the alloy is machined before heat treating, and has corrosion resistance better than 18-8 steel, stated Dr Cochardt. Another application may be in jet engine compressors where temperatures reach 800 F or higher.

According to Dr Zener, the research technique which produced the alloy is a result of the company's long-range materials development program. It promises to speed discovery of other new alloys, he added.

Fluor Corp Erecting Second CEPCO Plant

Fluor Corp, Ltd, Los Angeles engineering-construction firm, has been awarded a contract to design, erect and supervise preliminary start-up of the second of four 60,000-kw steam electric generating units for California Electric Power Co at its new San Bernardino Steam Plant.

Fluor is currently at work on construction of the first of these units on an 80-acre site south of Norton Air Force Base. Excavation for foundation work began in January and the first unit will be completed by July 1, 1957.

Field work on No. 2 unit will begin next January and its completion is scheduled for July 1958. Work on the project follows construction by Fluor of a 140,000-kw plant for Calectric at Highgrove, Calif.

Study of Union Contracts Finds Swing to Longer Pacts

Trend toward longer-term union contracts, first apparent in 1950, is continuing, according to a recent National Industrial Conference Board report on 923 union agreements signed between June, 1955 and May, 1956.

The Board finds that over half (56.0%) of these contracts run for more than one year. This compares with only 46.4% in 1950 (when NICB analyzed 303 contracts) and 24.6% in 1948 (based on 313 contracts). Historically, labor leaders have sought short-term agreements, usually ones that would run about a year.

Of the total contracts included in the present survey, 10.5% run for more than one year but less than two; 21.7% are two-year agreements; 6.8% have a term of over two but less than three years; while 14.4% run three years.

Welding Alloy Association Formed by Manufacturers

Resistance Welding Alloy Association has been organized by nine manufacturers of resistance welding electrodes and alloys. Address of the Association is 1900 Arch St, Philadelphia 3, Pa.

Officers of the Association are: President—Richard H. Taylor of Electroloy Co, Inc, Bridgeport, Conn.;

Vice President—James A. O'Grady of Weldaloy Products Co, Van Dyke, Mich.

The association management firm, Fernley & Fernley of Philadelphia, Pa., has been retained to carry on the work of the Association. Marie H. Lawton will serve as secretary-treasurer, and Thomas A. Fernley, Jr., is advisory secretary.

M&M BRIEFS

Multi-Amp Corp, formerly of Newark, has moved to 465 Lehigh Ave, Union, N. J. Here are the offices and a larger plant for the manufacture of relay and other high-current electrical test equipment.

Otis Elevator Co, New York, reports sales of operatorless automatic elevators amounted to 98.2% of all new intensive-service cars sold by the company in the U. S. for the 12-month period ending April 30, 1956. This is in comparison to 12.6% in 1950, 80% in 1953 and 95% in 1955. With this type of elevators, building owners are said to save as much as $8,000 a year per car in operating expense, and to provide more efficient service.

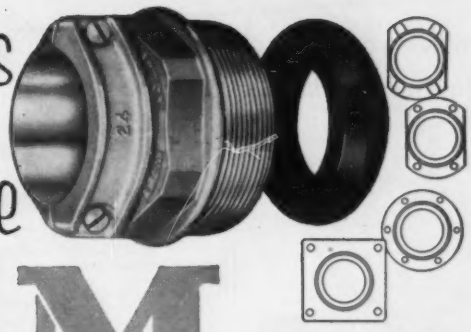
Joseph T. Ryerson & Son, Inc., Chicago, will sell Reynolds Metal Co aluminum in the area served by Ryerson's Chicago and Milwaukee plants. It has been a Reynolds aluminum distributor in New England.

Amana Refrigeration, Inc, Amana, Iowa, has acquired the trade name, all tools, dies and patents of Deepfreeze Appliance Division of Motor Products Corp which ceased operations March 31, according to George C. Foerstuer, executive vice president of Amana.

NAELCO, North American Electric Lamp Co, 1014 Tyler St, St. Louis, Mo., manufacturer of decorative and industrial lamp bulbs, moved to 1520 North 13th St, St. Louis, Mo.

C&D Batteries, Inc, a storage battery manufacturer in Conshohocken, Pa., is celebrating its 50th anniversary. The company has issued a brochure, entitled "Highlights of Fifty Years," to mark the occasion.

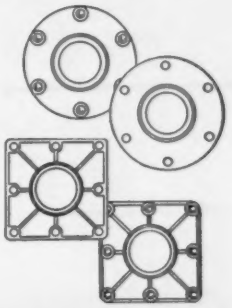
unusual needs in unusual time FROM PLM



PLM Armored Cable Terminators are supplied with many types of flange mountings, or for mounting through structures.

● Special needs don't have to mean special problems. PLM terminators and splicing accessories for armored cable include a wide variety of types for many uses... can be modified or supplied on special order for many other needs.

Put your problems up to PLM. Whether your specifications call for standard or special items for terminating or splicing of armored, rubber-insulated or lead-covered cable through 23 kv, you'll find fast and efficient help. Write, wire or phone. Catalog on request.



PLM Products, Inc.

3873 West 150th St. • Cleveland 11, Ohio

WIRE AND CABLE FITTINGS AND ACCESSORIES

Armored Cable Terminators • Splicing and Terminating Kits • Conduit Ventilators

GET Original FACTORY QUALITY

You are assured of highest quality when you specify Allis-Chalmers core and coil replacement assemblies. These are not rebuilt cores and coils, but completely new units, assembled and dried with the same skill and advanced equipment as standard A-C distribution transformers. All assemblies conform strictly to NEMA standards. They can be used in any make tank.

ALLIS-CHALMERS Core and Coil Replacement Assemblies

Complete Package for installation in 4 Simple Steps

All replacement units are packaged under oil in a specially designed metal container that protects against moisture and damage during transportation. Only 4 simple steps to install. Complete anchoring arrangement included with installation instructions.

Assemblies are available in ratings 25 kva and smaller, 15 kv and below. Use them in either conventional or protected types. Provision for mounting low voltage breaker, and a winding to operate signal light are standard.

Special moisture-proof package.

Complete replacement kit.

Get more information from your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 61B6345A. A-4885

ALLIS-CHALMERS

"When you're as old as me, sonny,
this meter will still be working!"

Tom Barnes, Mgr. Meter Engineering, Says:
"WE ARE CERTAIN THAT LOAD GROWTH WILL NEVER MAKE THIS METER OBSOLETE."

The New Westinghouse 30-Ampere Meter

Good news! For only pennies a year over the cost of ordinary meters, you can buy the new 30-ampere Westinghouse Lifetime Meter. It's good insurance against load-growth problems. This new meter will handle all single-phase loads up to 200 amperes.

Few homes *today* require 200-ampere meters. But how about the future? Industry forecasts predict a tremendous growth in the use of electric power, particularly in the home.

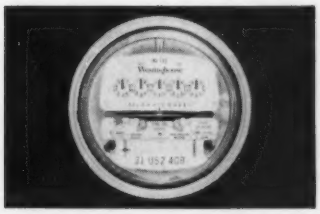
The 30-ampere meter gives you a substantial cushion against this future load growth. It is your guarantee that whatever the future, your meters will have the capacity to handle the load.

In most localities, testing requirements are the same as for 15-ampere meters. For only a little more, you get twice the metering capacity when you specify 30-ampere Lifetime Meters.

For more information, see your Westinghouse sales engineer or write Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pa.

J-40489

New 30-ampere meter gives you all the Lifetime features



10,000-volt impulse insulation level in current and potential coils. De-ion® gap discharges outside the meter at 6500-volt impulse for lightning protection. Corrosion resistance in all components. Full and light-load adjusters are linear, 20% range, accessible from the front.

Alnico damping magnets for extreme stability. Famous Westinghouse ball-and-jewel bearing, a proved Lifetime bearing.

WATCH WESTINGHOUSE

*WHERE THE **FUTURE** IS **ALREADY** IN PRODUCTION!*

Allen Gets Sales VP Post

New vice president in charge of sales for Philadelphia Electric Co is Milton I. Allen, general sales manager of the utility since early last year. In his new post Allen succeeds George E. Whitwell, who has retired.

Allen, who was instrumental in creating the company's industrial and commercial development division, joined the utility in 1928 following his graduation as an electrical engineer from Pennsylvania State College. He was assigned to sales work, as an industrial serviceman, and has spent his entire career in that department.

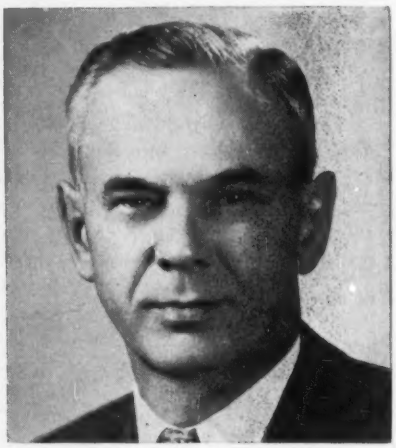
Following several years' experience as power salesman, he was appointed director of industrial sales in charge of the Main Line and Delaware Divisions in 1940. Two years later he became acting manager of the sales service division, and subsequently was named marketing assistant to the vice president in charge of sales.

MILTON I. ALLEN

Superior Elevates Nichols

Larry A. Nichols has been promoted from general sales manager of Superior Water, Light and Power Co to vice president and general manager of the company.

Nichols, who joined the utility as sales engineer in 1935, is a graduate of the School of Business Administration of George Washington University and previously attended Superior State College. Before joining the Superior company he was employed by Wisconsin Valley Electric Co and by the Lake Superior District Power Co. During his association with Superior he served in various capacities and in 1942 was appointed general sales manager of the utility.



LARRY A. NICHOLS

Abbott Named CEA Head

Newly elected president of Canadian Electrical Association for the 1956-57 session is Arthur C. Abbott, vice president of distribution, Shawinigan Water & Power Co, Montreal, Que.

Upon graduation in 1926 from McGill University as a mechanical and an electrical engineer, Abbott was employed by the Shawinigan company as a student apprentice. Two years later he was named assistant superintendent of Beauharnois Electric Co, Ltd, and became superintendent the next year. In 1930 he was appointed distribution engineer for Shawinigan's commercial and distribution department and from 1938 to 1950 he successively held the posts of electrical engineer, assistant manager, and manager of the commercial and distribution department.

ARTHUR C. ABBOTT

U. S. Steel Appoints Millard to Sales Post

MAXWELL D. MILLARD

Maxwell D. Millard, director of distribution and availability in United States Steel Corp's commercial department, has been appointed general manager of sales for the company's American Steel & Wire Division.

After starting his steel sales career as a technical apprentice with the division in 1934, Millard rose to foreman, and later served in a sales capacity with the wire rope sales department. In 1947 he was named assistant district manager of sales in Detroit, and became Detroit district manager two years later. His appointment as assistant general manager of sales for the Cleveland area in December, 1953, was followed six months later by promotion to his most recent post.

PERSONAL BRIEFS

New assistant secretary and assistant treasurer of Middle South Utilities, Inc, is **W. Donham Crawford** . . . Central Ohio Light & Power Co has named **A. A. Armbrust** to succeed retiring **Emory D. Erwin** as head of the company's operations in the Findley area.

Frederick L. Hecht, Jr, has been appointed design engineer of Connecticut Light & Power Co, succeeding **Edwin W. Roberts** who has retired after 38 years service . . . **Iver J. Petersen** has been named assistant superintendent of Hartford Light Co's South Meadow generating station, Hartford.

Appalachian Electric Power Co has named former Montgomery area supervisor **Jack Lloyd** as division area development representative for the Charleston and Huntington Divisions. **Ronald H. Hively, Sr,** succeeds Lloyd.

Arkansas Power & Light Co's **James V. Veneman** has been designated Fordyce manager to replace **Paul Bright,** who retires July 10.

Karl K. Garrett has retired as Greensboro manager of Duke Power Co, a post he has held since 1924. He is succeeded by **William J. Burton,** previously assistant manager.

E. Douglas Sutcliffe is new executive assistant to **W. C. Mainwaring,** president of B. C. Power Corp's new subsidiary Western Development & Power Ltd.

A. W. Edwards has been named to succeed **H. N. Muller, Jr,** as assistant to the vice president of apparatus products of Westinghouse Electric Corp. Muller becomes chief engineer of Canadian Westinghouse Co, Ltd . . . **R. M. Beatty,** former range department manager, Westinghouse Major Appliance Division, has been promoted to the newly created post of manager of utility sales. Replacing Beatty is **R. P. Brook.** New refrigerator-freezer department manager is **W. R. Arbuckle,** succeeding **S. J. Stephenson,** recently named Portable Appliance Division manager. And **F. A. Lowery** succeeds Arbuckle as manager, water heater and kitchen utilities department.

John B. Knaebel has been appointed assistant to the vice president of mining operations of Anaconda Co. **Albert J. Fitch** is new manager of New Mexico operations and **E. C. Peterson** becomes assistant manager.

Insulator Department of General Electric Co, Baltimore, has appointed **Robert R. Person** manager of manufacturing . . . GE's Distribution Assemblies Department has designated **Charles J. Falk** manager-engineering . . . In recent reorganization of the company's electronics components into three separate divisions **Harold A. Strickland, Jr,** was named head of Industrial Electronics Division; **L. Berkley Davis,** Electronic Components Division; and **George L. Haller,** Defense Electronics Division.

Howard J. McGuire is new vice president and general manager of the Remington Rand International Division of Sperry Rand Corp.

Two chief product engineers recently named by Wagner Electric Corp's Electrical Division are **H. B. Keath,** transformers; and **A. E. Frohardt,** motors.

Leeds & Northrup Co has promoted **G. Lupton Broomell, Jr,** from chief engineer to assistant director of engineering, acting head of the engineering and inspection departments, and a member of the executive operating committee. He succeeds **John W. Harsch,** director of engineering, who retires Aug 31.

Minneapolis-Honeywell Regulator Co's **George J. Schwartz** has been advanced from divisional vice president to vice president and general manager of the Doelcam Division . . . **Hal O. Chamberlain** has been named to the newly created position of manager of zone control sales for the company.

Captain Clifton G. Grimes, U.S.N. (Ret) has been appointed by Electric Storage Battery Co to fill the position of director of research vacated by the recent retirement of **Dr L. E. Lighton,** vice president and director of research.

Sylvania Electric Products, Inc, has designated **George C. Isham** general merchandising manager of the firm's sales department. Isham is former Eastern regional manager of distributor sales for electronic products.

Harold S. Geneen has joined Raytheon Manufacturing Co as executive vice president. He formerly served as vice president and controller of Jones & Laughlin Steel Corp.

OBITUARY

E. J. MacKenzie, 51, advertising manager of Simplex Wire & Cable Co for the past six years, died recently in Boston, Mass., from a heart ailment.

THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

A Threat to Economic Progress

THERE are two paramount reasons for concern over the serious shortage of scientists and engineers that now confronts the United States:

- The first reason, with which this editorial deals, is that continued expansion of our economy and further increases in our living standards are threatened unless we train more scientists and engineers and use them more effectively.
- The second reason for concern is that we run the risk of falling behind the Soviet Union in the technology so essential to national security. The consequences of losing this race to the Russians are not comforting. (The possibility that this might happen over the next few years was discussed in an earlier editorial in this series.)

The crucial contribution of scientists and engineers to the well-being of the American people has been to find ways of making better use of limited resources, to make equipment more productive, to develop new and better products that enrich our lives, to enable us to live longer and be healthier. They have made this contribution with greater success in the last 15 years than ever before, but it has required progressively more resources and more trained people.

During this 15-year period our annual production of goods and services, in dollars of constant purchasing power, has almost doubled. Since our total population has increased only 25 percent, this has meant a tremendous rise in the economic well-being of the American people as a whole. But in accomplishing this, the number of scientists and engineers has been more than doubled.

Tasks for Research

If the American economy is to continue to grow and if our living standards are to show further improvement, the work of scientists and engineers must be stepped up even more in the years ahead. Unless answers to several pressing problems are found through intensified research efforts, economic progress will become increasingly more difficult.

Productivity per hour of labor must be increased at a faster rate. Improved medical care has greatly increased the number of people who attain retirement age, and sharply higher birth rates since the war will mean larger numbers of children in school and college. Meantime, because of low birth rates during the depression, the number of people reaching working age is not rising nearly so fast. The result is that over the next 20 years our population will increase by about one-third, while the total manhours worked are not expected to increase more than 15 percent. So, simply to maintain the same living standards for a rising population — with no provision for additional improvements — ways must be found to enable each worker to produce for more dependents.

It is primarily to the scientists and engineers that we must look for help in making human labor more productive. This will require enormous increases in our power

resources. We will need to make more effective use of our existing fuel supplies — coal, oil and natural gas. And we will have to devise economically practical means of tapping other energy sources, particularly nuclear power and new rocket fuels.

Also, better ways must be found to use scarce and low-grade raw materials. Thanks to great strides in metallurgy and mining techniques, we are now utilizing sources of copper and iron ore that, for all practical purposes, were not available to us only ten years ago. Similar strides are needed in the mining and processing of bauxite if low-grade domestic ores are to help satisfy a fast-growing market for aluminum. And stubborn technical obstacles in the area of "high temperature" metals—such as nickel, cobalt, columbium, tantalum and titanium — are impeding progress in jet and turbine engines.

These are only a few of the challenging tasks that demand intensified research and engineering activity in the years immediately ahead if the United States is to continue to raise living standards. We need more houses, schools and highways for a rising population, more medical research to reduce further the ravages of illness, more research in chemistry and other sciences to sustain the flow of new and improved products that are so essential an ingredient of our economic progress.

Ceiling on Growth

American industry has indicated that it is ready to meet the challenge and undertake vastly expanded research programs. A recent survey conducted by the McGraw-Hill Department of Economics revealed that total research and development expenditures of American industry were almost $5 billion last year, 29% higher than in 1953. By 1959 business plans to be spending well over $6 billion on research and development. And the total could well prove to be much higher, based on the trend of recent years.

But industry's programs for research and development cannot be carried out unless enough qualified research workers and engineers are available. Ernest R. Breech, chairman of the Ford Motor Company, recently described the supply of engineers as the "ceiling on our future growth." He gave force to his point by announcing: "If 900 qualified engineers were to approach us next week looking for jobs, we would hire every one." The U. S. Bureau of Labor Statistics found in interviews with some 200 large companies at the end of 1954 — a recession year — that at least half were unable to hire enough research scientists and engineers to meet their needs. A third of the companies reported substantial shortages of technical personnel.

The shortage of technically trained people, furthermore, is becoming more acute. The number of engineers and scientists now being graduated is only about enough to cover replacement requirements, while the needs of industry, government and education are mounting every year. According to the best information available — as indicated in the first editorial in this series — these needs are now about twice as great as our current engineering graduating classes and annual production of scientists with Ph. D. degrees.

To perform the research needed to remove roadblocks to our economic progress — and at the same time hold our own in the technology essential to our security as a free nation — we must have an adequate supply of men and women with engineering and scientific training. Instead, we are faced with an acute shortage, now and for several years to come. Reasons for the shortage and proposals for working our way out of the shortage will be discussed in the remaining two editorials in this series.

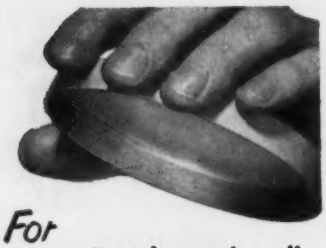
This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.



For "small-job sealing"...

Johns-Manville

Duxseal

in the new handy pocket roll

THE NEW HANDY pocket roll makes Duxseal® ideal for small sealing jobs in both installation and maintenance work. It thereby increases the usefulness of your favorite all-purpose sealing and caulking compound.

The NEW pocket roll container allows quick removal and replacement of the compound. Its ribbon form makes Duxseal easy to apply in any amount, large or small.

3 types of Duxseal are now available in pocket rolls:

- **STANDARD DUXSEAL** is a permanently plastic gray-green compound utilizing a non-drying, vegetable-oil vehicle. It will not corrode metals, plastics, wood, rubber, or painted surfaces. It adheres well to all common materials. It is non-staining.
- **TYPE N DUXSEAL** has the same properties plus higher resistance to bleeding or dripping at high temperatures.
- **R-100 DUXSEAL** employs a resinous material as its vehicle and has the same properties. It skins fast to provide an excellent paint surface.

A wide range of other J-M Sealing Compounds is also available in pocket rolls. These are described in sheet EL-85A. Duxseal is covered in sheet EL-68A. Write Johns-Manville, Box 60, New York 16, N. Y.

Johns-Manville

DUXSEAL

SALES ASSIGNMENTS

COMPANY STAFFS

Allis-Chalmers Manufacturing Co's Industries Group has assigned Charles E. Gearing to the Birmingham district office as sales representative.

Babcock & Wilcox Co has named Seth M. Snyder manager of the Boiler Division's Charlotte, N. C., office.

Electric Service Manufacturing Co's new St. Louis (Mo.) district manager is Lawrence R. Hurley. His territory will consist of Missouri, Nebraska, Kansas, Kentucky, and portions of Indiana, Iowa, Illinois, and Ohio.

Federal Pacific Electric Co has named John W. Muse New England promotional sales manager.

General Electric Co's Insulator Department has appointed R. O. Lanoue as sales manager of the north central sales region, including Wisconsin, upstate Illinois, Indiana, Ohio, and Michigan. A. B. Caprara is new district manager for the New England sales district. . . . Carboloy Department of GE has named Harry E. Mitchell carbide tools sales representative in the midwestern district.

Line Material Co has designated Maury A. Babin field engineer in southeastern Texas, with headquarters in Houston.

Westinghouse Electric Corp had added eleven new district managers to its portable appliance field sales force. They are G. A. Goettsche, portable appliances, Philadelphia area; V. A. Sayre, vacuum cleaners and fans, Pittsburgh area; C. J. St. George, portable appliances, Detroit; Harold W. Fisher, portable appliances, Omaha, Neb.; R. M. Lewis, vacuum cleaners, Chicago; V. J. Tumbarello, portable appliances, Chicago; R. R. Kruse, portable appliances, Kansas City; R. H. Rufener, portable appliances, Salt Lake City; G. E. Thompson, vacuum cleaners and fans, Los Angeles; R. G. Marshall, portable appliances, Long Beach; and E. H. Ringold, portable appliances, Atlanta.

Chase & Sons, Inc, has appointed Leonard P. Graham sales manager, Cable Tape Division. He will be assisted by James Cochrane as technical representative. Robert C. Graham is new sales manager, Laminated & Reinforced Insulation Division, and Joseph Permetti becomes New England manager for Friction tape.

REPRESENTATIVES

Miller Co has announced the appointment of J. C. Epperson Co as sales representative for the Illuminating Division in the California area.

J. F. Pritchard & Co has named R. A. Darling of the R. A. Darling Co as sales representative for Colorado, Wyoming, western South Dakota, and western Nebraska.

Before: Beat-up

Now: Like new!

G-E Service Shop

Your local G-E Service Shop uses mass-production methods when it rebuilds your old distribution transformers. Result: high-quality work at low cost . . . prompt pickup and delivery . . . and no worries for you. And you get new-unit warranties! There are 31 G-E Service Shops throughout the country—one near you. 431-32

Progress Is Our Most Important Product

GENERAL ELECTRIC

Louisville's Used Car Lots Outpower Street Lights

From a story in the "Louisville Courier Journal" come these statements under Harry Shaw's by-line:

Used car lots in Louisville burn about twice as much electricity as the city uses to light its streets. The average used car dealer pays about $300 a month for electric light. There are 175 used car lots, so these dealers pay about $52,000 a month, or $630,000 a year, for light.

In contrast, Louisville pays $27,000 a month or $324,000 a year for street lighting.

Shaw wrote that about four bulbs a day must be replaced because of theft or burning out. This comes to 255,500 bulbs a year at 16¢ a bulb, or $40,880.

One operator of an average sized lot stated that his lighting cost $285 to $305 a month, more than the $210 rental he pays for the lot. A second dealer said he had to sell three cars a month to pay the light bill.

The largest user of lights estimated he had 2,500 75-w bulbs. Smaller users have 150 to 1,500. The average probably runs about 1,000 per lot, and the total around 175,000 bulbs. It appears that most dealers use the 75-w variety. They burn about 6 hr a day.

British To Experiment in Burning Coal Underground

Britain's National Coal Board and Central Electricity Authority have accepted responsibility for the planning and construction of a pilot plant for the underground gasification of coal.

The Minister of Fuel and Power, Aubrey Jones, who announced this recently in the House of Commons, added that the two nationalized authorities had also undertaken to explore the possibilities of exploitation on a commercial scale.

"I have indicated to both authorities the importance of developing with the utmost expedition this important new technique as well as my wish that private enterprise should be associated with it, so that full advantage of its successful development can be taken in overseas markets," he added.

The Minister also stated that even if a successful pilot plant were constructed it would inevitably be some years before a full-scale commercial plant could be brought into operation.

1. DIGS THE HOLE! **2.** LIFTS THE POLE! **3.** OPERATION FINISHED!

acker digger makes pole setting as easy as 1.2.3.

The Acker Digger makes short work out of pole setting. *It digs the hole* — up to 22" in diameter. *It lifts the pole* — a built-in cathead winch easily handles loads up to 1250 lbs.

Yet, for all of its rugged, sturdy construction, its compact, lightweight design permits mounting on a small truck. And, it performs equally well on crowded city streets, or isolated open country.

Make us prove that the Acker Digger is best for you. Write for Bulletin 40.

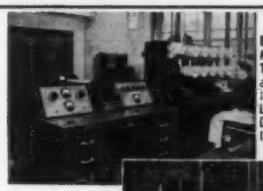
ACKER DRILL CO., Inc.
725 W. Lackawanna Avenue
Scranton, Penna.

Manufacturers of a complete line of Diamond and Shot Core Drills, Drilling Accessories and Equipment

They ALL Picked STATES

Illustrated are just a few of the many utility companies now testing with **States Test Table Equipment.** North, South, East and West—more utilities have selected States Test Tables for dependability, accuracy and versatility. Practically every model of States Watt-hour Meter Table will test both single phase and two and three element polyphase meters.

There's a STATES TABLE for practically every testing purpose



DEMAND METER TEST at Iowa Power & Light Company Des Moines, Iowa

AUTOMATIC SEQUENCE at Duke Power Co. Greenville, S. Carolina

PHOTO ELECTRIC CONTROL at S. Carolina Electric & Gas Company Columbia, S. Carolina

ALL PURPOSE TABLE at Light & Power Dept. Port Angeles, Wash.

STROBO and PHOTO ELECTRIC CONTROLS at Houston Lighting & Power Company Houston, Texas

THE STATES COMPANY
Plate Handsomely

THE STATES COMPANY
19 New Park Avenue, Hartford, Conn.

I am interested. Please send me more information STATES TEST TABLES.

Name ..... Title .....
Firm Name .....
City .....Zone....State.....

STEEL

Every Kind

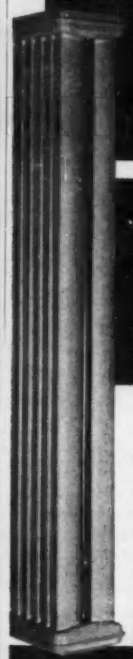
Quick Delivery

Plates, Structurals, Bars, Sheets, Tubes, etc. Carbon, Alloy, Stainless Steels, Babbitt Metal.

RYERSON

Plants at: New York • Philadelphia Boston • Wallingford, Conn. • Charlotte, N. C. • Cincinnati • Cleveland Detroit • Pittsburgh • Buffalo • Chicago Milwaukee • St. Louis • Los Angeles San Francisco • Spokane • Seattle

SHAW-PERKINS COOLING RADIATORS



. . . properly designed to cool power and distribution transformers

Designed and built by the pioneers and specialists in economical, dependable self-cooling methods. Sizes and models for any make transformer. Valves, flanges, elbows available. Transformer tanks built to customer's design.

Write for full information. SP-11

MANUFACTURED BY

SHAW-PERKINS

201 EAST CARSON ST. • PITTSBURGH 19, PA.

PREMAX

METAL MARKERS

ATTACH IN SECONDS AND LAST FOREVER

Premax letters, figures and special tags insure positive, permanent identification for all utility poles, towers and installations. Made of stamped or embossed brass or aluminum to retain high legibility regardless of weather.

R. E. A. approved. Ask your dealer or write:

PREMAX PRODUCTS

Div. CHISHOLM-RYDER Co. Inc.
5651 Highland Ave., Niagara Falls, N. Y.

If . . . You Change Your Address

Be sure to notify us at once so future copies of Electrical World will be delivered promptly.

Also make certain you advise your local Postmaster, so other important mail doesn't go astray. Both the Post Office and we will thank you for your thoughtfulness.

Send your new and old address to: Subscription Dept.

ELECTRICAL WORLD

330 W. 42nd St. **New York 36, N. Y.**

Giant Australia Dam

. . . to be completed by U. S. contractors group sponsored by Kaiser

A joint venture group of contractors under the sponsorship of Kaiser Engineers Division of Henry J. Kaiser Co, has been awarded a $12 million contract for the completion of Adaminaby Dam in New South Wales.

The structure, one of the highest earth and rock filled dams in the world, is a major part of the Snowy Mountains hydroelectric development in southeast Australia, contracts for which have been also let to Norwegian and French interests.

Located near Adaminaby, the dam will block the Eucumbene River, creating a reservoir of some 3½ million acre-ft of water to be diverted into the 14-mi. tunnel under construction by Kaiser-Walsh-Perini-Raymond since early 1954.

Adaminaby Dam, scheduled for completion in 1960, will be 390 ft high by 1,500 ft long. It will contain some 9-million cu yd of earth and rock.

Preliminary work on Adaminaby Dam has been under the direction of the Department of Public Works. Its completion by the joint venture group will coincide with completion of the 25-ft diam, 14-mi. tunnel, switching the Eucumbene River from a southeasterly to a westerly course.

It will enable an average of 300,000 acre ft of water yearly to be released down the Tumut River to the irrigation areas of the Murrumbidgee Valley. By 1962, this will be increased to an annual diversion of 500,000 acre ft.

The Snowy Mountains hydroelectric development includes the construction of 7 dams, 80 mi. of large diam tunnel and 17 power stations. It will provide southeastern Australia with 3,000,000 kw of power and 2,000,000 acre-ft of water yearly for irrigation.

The American group consists of Kaiser Engineers Division of Henry J. Kaiser Co as the sponsor, and includes Walsh Construction Co, New York; B. Perini & Sons, Inc., Framingham, Mass.; Raymond Concrete Pile Co, New York; General Construction Company, Seattle; Bates & Rogers Construction Corp, Chicago; and Arthur A. Johnson Corp, New York.

Two New Minerallac Quality Products Designed for Jobs Too Heavy for Standard Jiffy Clips

MINERALLAC
Heavy Duty AND Medium
JIFFY CLIPS

Also available without mounting hole for use with gun.

patent pending

Made of heavier materials! Has exclusive inverted rib, that provides more strength at the bend of clip . . . and, of course, adds the benefits of famous "Snap On" feature!

In stock in Zinc-Plated Steel for Thin Wall or Rigid Conduit up to 6". (Hot Dipped Galvanized may be obtained on order) Can be substituted for malleable clips.

Order From Your Electrical Wholesaler

SEND FOR LITERATURE
MINERALLAC ELECTRIC COMPANY
25 North Peoria St. Chicago 7, Ill.

MINERALLAC

REPLACE THEM
NOW!
THE OVERTON
Flexibal
WAY
ECONOMICALLY — EASILY

1. Slip Over Wire
2. Drive Home Nail
3. Attach Clamp

IT'S AS SIMPLE AS THAT!

Costs ⅓ less than Metal Guards and No Maintenance Problem

ORDER NOW —
IMMEDIATE DELIVERY

SEE YOUR JOBBER OR WRITE TO
S. E. OVERTON COMPANY
SOUTH HAVEN, MICHIGAN

Southern California Edison Plans $60 Million Plant

Southern California Edison Co has been granted permission by California Public Utilities Commission to construct, at a cost of over $60 million, a steam plant at Huntington Beach, Calif. To be located on a 60-acre site, the plant will initially contain two 200,000-kw units, but two more may be added later.

Construction by Bechtel Corp will begin this summer. First unit is scheduled for completion in June 1958, and the second in December 1958.

Design is of the cross-compound type, with each unit containing a high pressure, reheat, and low pressure turbine on rotating shafts (3,600 rpm for the high pressure elements and 1,800 rpm for the low). A separate 128,000-kva generator is to be coupled to each shaft in a cross-compound arrangement.

Energy will be generated at 13.8 kv, with a step up to 220 kv by three single phase 82,000-kva transformers, at each unit. Plans call for a single boiler per unit with an operating capacity of 1,560,000 lb of steam per hr, and the use of oil and natural gas.

A Stifled Voice Speaks

The Clarksville (Tenn.) Chamber of Commerce has accused the U. S. Chamber of Commerce of attempting to "strangle" TVA and stifle protesting voices of its member chambers. Richard M. Hawkins, president of the Clarksville chamber, wrote Chairman Clarence Cannon (D-Mo.) of the House Appropriations Committee condemning the national organization for denying a voice to any of its member groups if they disagreed with national policy. He called on other Tennessee chambers for help in "publicly exposing the national organization's aim to harm" the people of the region.

Jurors Back Portland GE

An Oregon grand jury has vindicated Portland General Electric Co of alleged violations of state hydroelectric law, and refused to return the indictment called for by the state's attorney general. The company started construction of Pelton dam under Federal Power Commission license without obtaining an Oregon permit.

Save time testing watthour meters with the

KNOPP

Meter-Testing Equipment, Type TE-7

Power companies the nation over, save time, save money, and build customer goodwill when testing watthour meters with the Knopp Meter-Testing Equipment.

Has Knopp Uniload† System with Unilink† series-test feature enabling testing of both elements of a 3-wire, single-phase meter simultaneously without opening the potential link.* Basic constant of rotating standard adjustable to match basic constant of meter-under-test.* Its new, more-convenient switching arrangement for connecting meter elements permits 2-element and 3-element polyphase meter testing without changing connections. Includes photoelectric counter and other time-saving features for accurate testing.

Tests all types of watthour meters. Provides voltage ranges of 120, 240, and 480; current ranges of .25, .5, 1, 1.5, 2.5, 5, 10, 15, 25, and 50. Overall equipment accuracy within .05%.

*Patented †Trademark

KNOPP Phase Shifter

You can have any leading or lagging phase angle by manually controlling the position of the rotor. One scale shows degrees for electrical angle of displacement; another, corresponding power-factor values. Gives true power-factor readings under all conditions. Highly accurate. Input: 120/240 v. 3-phase, delta. Output: 120 or 240 v. 3-phase, delta. Other ratings available.

Also: Knopp Precision Transformers; Knopp Standard Burden Sets; Knopp Uniload Equipment for testing instruments and instrument transformers.

For complete technical descriptions please write us today

KNOPP INC.

Founded in 1928 by Otto A. Knopp under the name of Electrical Facilities Inc.

4236 Holden St., Oakland 8, Calif.

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

RATES

DISPLAYED

The advertising rate is $19.15 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.
Subject to Agency Commission.

UNDISPLAYED

$1.50 per line, minimum 3 lines. To figure payment count 5 average words as a line. Box Numbers—counts as 1 line.
Position Wanted ads, ½ of above rate.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS and inquiries to Classified Advertising Division of ELECTRICAL WORLD, P.O. Box 12, N. Y. 36, N. Y.

INSTRUMENT TRANSFORMER SALES ENGINEER

Splendid opportunity for sales minded engineer to advance rapidly with major electrical manufacturer. Very pleasant headquarters location. Travel required. All enquiries will be kept absolutely confidential.

Write to

P-2098, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

ENGINEERS ELECTRICAL

DESIGN

Plants and Substations
Distribution and Transmission
Including Underground
Network Systems
Relay Systems
Technical Studies

SYSTEM PLANNING ENGINEERS

Required by Operating Division of long established service and supervisory organization for large group of Electric Utilities located in eleven Latin American countries. Engineering assignments varied and interesting with responsibility. Salary commensurate with ability. Usual employee benefits. Reply giving age, education, experience, personal particulars and salary expected.

AMERICAN & FOREIGN POWER COMPANY INC and SUBSIDIARIES

2 Rector St., New York 6, N. Y.
21st Floor DI 4-4480 Ext 8494

SENIOR ELECTRICAL ENGINEER

Foreign Employment

Graduate EE with minimum 10 years' supervisory experience in utilities systems planning, study and design work. Must be generally familiar with power generation, transmission and distribution. For The Hague, Holland Engineering Office. Generous salary plus rent allowance. Liberal all-inclusive benefit program.

PROCESS ENGINEER

Graduate EE or ME with minimum 5 years' experience to handle technical aspects of power plant with gas combustion turbine integrated with steam plants, electrical motors, distribution and automatic control systems. 2 Years' supervisory experience desirable. For Operations Department located in Saudi Arabia. Generous salary plus living allowance: liberal all-inclusive benefit program.
Write giving full particulars regarding personal history and work experience.

Recruiting Supervisor, Box 148

ARABIAN AMERICAN OIL COMPANY
505 Park Avenue New York 22, New York

ELECTRICAL ENGINEERS STEAM POWER PLANTS

Excellent positions as project engineers for man experienced in the design and engineering of steam electric power plants and power systems.

These are permanent positions offering opportunity for advancement with an established, recognized firm serving the growing electrical utility industry. Many liberal employee benefits, including pension plan. Please submit resume of education and experience. State age and salary requirements. All replies will be treated confidentially.

J. B. Christerson

SARGENT & LUNDY
140 So. Dearborn St.
Chicago 3, Illinois

TRANSMISSION ENGINEER

Research and Development

Challenging opportunity for Electrical, Structural or Mechanical Engineer to work on high voltage transmission line problems. Preferably with considerable structural-mechanical experience involving conductor sag-tension, wind and ice loading, sleet, galloping conductors, vibration, fatigue, dampers, line hardware and accessories. Electrical experience, especially that involving corona, radio and television interference also desirable. Research and development experience not necessary but must be qualified to organize laboratory and field investigations and to evaluate the results. Salary open. Reply to:

Dr. E. W. Greenfield, Head,
Electrical Engineering Branch,
Department of Metallurgical Research
Kaiser Aluminum & Chemical Corporation
Spokane 69, Washington

WANTED

SALES ENGINEER

with utility experience and the ability to handle all phases of new business connected with utilities. Age: Under 45. Liberal salary and traveling expenses.

P-1650, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL ENGINEERS

Assistants to project engineers will be interviewed. Well rounded men having 3 to 4 years experience, BS degree, interested in design of specialty transformers and voltage regulators needed. This is an opportunity to work in New England with a smaller company. Send complete resume including education, experience, salary and history to:

William P. Carpenter
THE SUPERIOR ELECTRIC COMPANY
Bristol, Connecticut

OPERATING ASSISTANT

For rapidly growing electric utility in Northern New Jersey. Graduate Electrical Engineer desired. To assist Substation & Transmission Superintendent in directing construction and maintenance crews, evaluating tests of equipment and administering maintenance and replacement schedules. Excellent advancement opportunities. Reply giving training and experience.

P-2228, Electrical World
Class. Adv. Div. P.O. Box 12, N.Y. 36, N.Y.

Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publisher to secure more advertisers and—more advertisers mean more information or more products or better service—more value—to YOU.

Factory Representative

Desires connection with electrical construction materials manufacturer. Well established electrical wholesaler clientele. Southern Illinois, Western Kentucky, and Eastern Missouri.

RA-2144, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.): Address to office nearest you c/o This publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1125 W. 6th St. (17)

POSITIONS VACANT

Product Engineer—Graduate engineer with utility experience in transmission and distribution desired, for design and quality control with company manufacturing power line connectors, splices and deadends. Will work closely with sales and production departments as well as other engineers. We know this is the same old ad, but it got us a good man last time, and he has been promoted. Salary open. Reliable Electric Company, 3145 Carroll Avenue, Chicago 12, Illinois.

Operations Assistant Engineering graduate with utility operating experience and some knowledge of utility accounting. Work directly under direction of Vice President on analyses of property operations of diversified utility. Heavy travel. Submit complete resume and starting salary desired. P-1879, Electrical World.

Austrian manufacturer drumswitches and other industrial controls with office located New York requires energetic sales engineer able travel throughout USA. Drawing commission bright future. If interested write Box P-1943, Electrical World stating all qualifications which should include some electrical engineering experience.

EMPLOYMENT SERVICES

Salaried Personnel, $5,000-$30,000. This Confidential service established 1920, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, P. O. Box 674, Manchester, Vermont.

Salaried Positions $5,000 to $35,000. We offer the original personal employment service (established 46 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars. R. W. Bixby, Inc., 558 Brisbane Bldg., Buffalo, N. Y.

PERIODICALS

A.I.E.E. Transactions wanted to buy for cash and other technical and scientific periodicals. E. W. Ashby 27 E. 21; N.Y.C. (10)

U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-4708) will be received at Denver, Colorado, until August 9, 1956, for furnishing one indoor, 1,000-kva, double-ended, unit substation; one main control board; unmounted switchboard equipment; and carrier-current transmitter-receiver sets for Casper, Gering and Lingle Substations, Flatiron Dispatching Station and Glendo and Guernsey Power Plants, Missouri River Basin Project, Wyoming and Nebraska. Delivery is desired within 120 to 300 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 2, Colorado. W. A. Dexheimer, Commissioner.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES · EQUIPMENT - USED or RESALE

UNDISPLAYED —RATES— **DISPLAYED**

$1.50 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals.)

The advertising rate is $14.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISING to Classified Advertising, P. O. Box 12, N. Y. 36, N. Y.

FOR SALE
USED ELECTRIC MOTORS AND MOTOR GENERATOR SET

Motor Generator Set consisting of 1—175 K.V.A. Westinghouse A/C Generator, 3 phase, 60 cycle, 220 volts, 1200 R.P.M. 4-¾ K.W. D/C Generator direct connected, 100 H.P. Mather Platt Air Cooled Motor, 3 phase, 25 cycle, 2300 volts, 1500 R.P.M. driven by 10 strand texrope drive complete control switch panel resistances, wired in conduit C.I. mutual base. In excellent condition.

2, 100 H.P. Mather Platt 220 volt, 3 phase, 25 cycle protected enclosure, 750 R.P.M. Round Rotor, Type L13 with control panels and Resistors.

2, 10 H.P. Mather Platt 220 volt, 3 phase, 25 cycle protected enclosure, 750 R.P.M. Double Shaft.

APPLY

J. M. WAITE
HAMILTON SPECTATOR,
HAMILTON, ONT.

TRANSFORMERS

SPECIAL PURCHASE

five carloads
13800 volt transformers
sizes 25 KVA to 250 KVA
new and slightly used

What can you use?
Write for list and prices

Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
5316 Hetzel St.
Cincinnati 27, Ohio

40 Years' Dependable Service

FOR SALE
SUBJECT TO PRIOR SALE

200 Westinghouse Type CO, Inverse Time Relays, Rated 0.5/2.5 Amperes, 60 Cycle, with Universal Operation Indicator. In Modern Flexitest Cases Which Can Be Mounted Either Flush or Projection. All in First Class Condition. Can Be Used Interchangeably. Styles Nos. 1271197, 1273197, 1545024 and 1545012. If Interested Contact N. C. Stirewalt, V. P., Central Illinois Public Service Company, Springfield, Illinois.

ELECTRICAL WIRE AND CABLE

—YOUR BEST SOURCE—

• for every industrial and power application
• Odd lengths—long and short—reasonably priced

One of the Largest Stocks in the Midwest

Let us quote on requirements—
send your inquiries
We'll also buy your Surplus

Branch Office:
Houston—Walnut 3-4580
FOR YOUR TEMPORARY NEEDS TRY OUR SURPLUS DIVISION

UNIVERSAL WIRE and CABLE Co.
2929 N. Paulina St. Chicago 13, Ill.
EAstgate 7-4777 Code: UNIWIRE

TRANSFORMERS

Qu.	KVA	Mfgr	Type	Form	Voltage
3	1667	G.E.	OAP	VD	68,000-19,100/33,000Y

Priced For Quick Sale

MARYLAND PIPE & METALS COMPANY, INC.
304 West Church St. Hagerstown, Maryland

WANTED — TRANSFORMERS

3 phase 6600 or 7200 volts
75—100 KVA

ATLANTIC ELECTRIC METER CO.
214 East 41st Street New York 17, N. Y.
Wire or telephone collect Murrayhill 2-4630

LARGE POWER EQUIPMENT

Prompt Stock Shipment
RENUBILT MOTORS - GENERATORS
TRANSFORMERS - CIRCUIT BREAKERS
DO YOU GET OUR STOCK LIST?

BELYEA COMPANY INC.
51 Howell St. Jersey City, N. J.

If there is anything you want
that other readers can supply
OR . . . something you don't want—
that other readers can use—
Advertise it in the
SEARCHLIGHT SECTION

FOR SALE
Used Oil Circuit Breaker

General Electric FK-20, Cat. 167386, 60 ampere, 2500 volts, 60 cycles, 3 pole, single throw, R.P. 2810. Condition good. Board of County Commissioners, P.O. Box 271, Sarasota, Florida.

MEETINGS CALENDAR

JULY

*** ELECTRIC COMPANIES PUBLIC INFORMATION PROGRAM**—West North Central Interstate Power Company, Dubuque, Iowa, July 12.

SOUTHEASTERN ELECTRIC EXCHANGE—Personnel Administration Section, General Oglethorpe Hotel, Savannah, Ga., July 12-13.

*** AMERICAN POWER DISPATCHER'S ASSOCIATION**—Summer Southwest Area Meeting, Pasadena Elks Club, Pasadena, Calif., July 13.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION—Council Meeting, Geneva, Switzerland, July 16-21.

NATIONAL ASSOCIATION OF RAILROAD AND UTILITIES COMMISSIONERS—Annual Convention, Sheraton Palace Hotel, San Francisco, Calif., July 24-27.

COLUMBIA UNIVERSITY INDUSTRIAL & MANAGEMENT ENGINEERING DEPARTMENT—Fifth Annual Utility Management Workshop, Arden House, Harriman, New York, July 29-Aug. 10.

AUGUST

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Heat Transfer Division, First National Conference, Pennsylvania State University, Aug. 11-15.

WESTERN ELECTRIC SHOW AND CONVENTION—Pan Pacific Auditorium and Ambassador Hotel, Los Angeles, California, Aug. 21-24.

SEPTEMBER

NORTHWEST PUBLIC POWER ASSOCIATION, INC—Accounting Section, Cascadian Hotel, Wenatchee, Wash., Sept. 11-14.

EDISON ELECTRIC INSTITUTE—Organization Meeting, sponsored jointly with AGA, Edgewater Beach Hotel, Chicago, Ill., Sept. 13-14; Industrial Relations Round Table Conference, Drake Hotel, Chicago, Ill., Sept. 17-19; Meter & Service Committee, Purdue University, Lafayette, Ind., Sept. 24-26.

PUBLIC UTILITIES ASSOCIATION OF THE VIRGINIAS—38th Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., Sept. 14-15.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—3rd Annual Electrical Conference of the Petroleum Industry, Kansas City, Mo., Sept. 17-19.

ILLUMINATING ENGINEERING SOCIETY—National Technical Conference, Hotel Statler, Boston, Mass., Sept. 17-21.

INSTRUMENT SOCIETY OF AMERICA—11th Annual Instrument-Automation Conference and Exhibit, New York Coliseum, Sept. 17-21.

ATOMIC INDUSTRIAL FORUM, INC—3rd Annual Forum Conference and 2nd Annual Trade Fair, Morrison Hotel and Navy Pier, Chicago, Ill., Sept. 24-28.

PENNSYLVANIA ELECTRIC ASSOCIATION—Annual Meeting, Hotel Wm. Penn, Pittsburgh, Pa., Sept. 25-26.

ELECTRIC COMPANIES PUBLIC INFORMATION PROGRAM—Steering Committee, Blackstone Hotel, Chicago, Ill., Sept. 26; Workshop Conference, Blackstone Hotel, Chicago, Ill., Sept. 26-28.

OCTOBER

EDISON ELECTRIC INSTITUTE—Prime Movers Committee, Radisson Hotel, Minneapolis, Minn., Oct. 1-3; Area Development Committee Meeting, Oct. 3, and Area Development Committee Workshop, Radisson Hotel, Minneapolis, Minn., Oct. 4-5; Electrical Equipment Committee, Hotel Statler, Cleveland, Ohio, Oct. 15-16; Transmission and Distribution Committee, Hotel Statler, Buffalo, N. Y., Oct. 18-19.

ILLINOIS INSTITUTE OF TECHNOLOGY—12th Annual National Electronics Conference, sponsored jointly by AIEE, Institute of Radio Engineers, University of Illinois, and Northwestern University, Hotel Sherman, Chicago, Ill., Oct. 1-3.

NATIONAL ELECTRONICS CONFERENCE—12th Annual Conference and Exhibition, Hotel Sherman, Chicago, Ill., Oct. 1-3.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Fall General Meeting, Morrison Hotel, Chicago, Ill., Oct. 1-5.

CANADIAN ELECTRICAL MANUFACTURERS' ASSOCIATION—12th Annual Meeting, Sheraton Brock Hotel, Niagara Falls, Ontario, Canada, Oct. 3-5.

STANDARDS ENGINEERS SOCIETY—Fifth Annual Meeting, Hotel Willard, Washington, D. C., Oct. 3-5.

INDIANA ELECTRICAL ASSOCIATION—Annual Convention, French Lick Springs Hotel, French Lick, Ind., Oct. 3-5.

SOUTHEASTERN ELECTRICAL EXCHANGE—Sales Conference, Tides Hotel & Bath Club, St. Petersburg, Fla., Oct. 3-5.

INTERNATIONAL ASSOCIATION OF ELECTRIC LEAGUES—Sheraton-Cadillac Hotel, Detroit, Mich., Oct. 3-6.

ROCKY MOUNTAIN ELECTRICAL LEAGUE—Annual Fall Convention, Broadmoor Hotel, Colorado Springs, Colo., Oct. 7-10.

INTERSTATE POWER CLUB—Hotel Martinique, New York, New York, Oct. 8.

ILLINOIS INSTITUTE OF TECHNOLOGY—Conference on Computer Applications, Chicago, Ill., Oct. 9-10.

INTER-INDUSTRY FARM ELECTRIC UTILIZATION COUNCIL—National Power Use Workshop, Milwaukee Auditorium, Milwaukee, Wis., Oct. 15-16.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Electrification of Machine Tools Conference, Sheraton-Gibson Hotel, Cincinnati, Ohio, Oct. 22-24.

UNIVERSITY OF TEXAS—Ninth Power Distribution Conference, University Batts Auditorium, Austin, Tex., Oct. 22-24.

AMERICAN STANDARDS ASSOCIATION—38th Annual Meeting and 7th National Conference on Standards, Hotel Roosevelt, New York, Oct. 22-24.

NATIONAL SAFETY COUNCIL—44th National Safety Congress & Exposition, Chicago, Illinois, Oct. 22-26.

NOVEMBER

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION—Annual Meeting, Traymore Hotel, Atlantic City, Nov. 12-16.

EDISON ELECTRIC INSTITUTE—Industrial Relations Committee, EEI Headquarters, New York, N. Y., Nov. 15; Accident Prevention Committee, Statler Hotel, Hartford, Conn., Nov. 26-28.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—22nd National Exposition of Power and Mechanical Engineering, Coliseum, New York, N. Y., Nov. 25-30.

DECEMBER

INSTITUTE OF RADIO ENGINEERS—2nd Instrumentation Conference, Biltmore Hotel, Atlanta, Ga., Dec. 5-7.

EDISON ELECTRIC INSTITUTE-AMERICAN GAS ASSOCIATION—1957 Conference Planning Committee, EEI-AGA Headquarters, New York, N. Y., Dec. 6-7.

* Additions This Week.

TVA Stations Plan Expansion

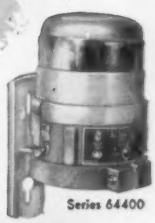
To meet expected 1958-1959 load, construction of two additional generating units has been started for TVA's Johnsonville steam plant in West Tennessee. The plant now has six units with a combined capability of 750,000 kw. A third unit, meanwhile, has been started for the Gallatin steam plant near Nashville. It will have a 275,000-kw capacity.

design advantages

OF FISHER-PIERCE

PHOTOELECTRIC LIGHTING CONTROLS

Any utility field man who has installed a Fisher-Pierce photoelectric control knows firsthand the many advantages of its clean, straightforward design. He appreciates, for example, time-saving plug-in installation of the one-piece electronic head; the ease, speed and safety with which he can handle compact F-P controls; the clean meter plate that has nothing to interfere with external wiring; the easily checked fuse. He knows the weatherproof glass enclosure design gives him quick, easy access to the control chassis; that he can orient an F-P control after mounting; and that component layout permits trouble-free servicing as well as maximum impulse strength. These advantages are important to the utility itself as well as the field man, since they mean rapid, low-cost installation and substantially reduced maintenance. Only F-P controls provide these advantages, *plus* these four other important features:



Series 64400

Series 63300C

COMPONENT QUALITY — Pre-aged, long life tubes • Wire wound potentiometer • Metal encased capacitors • Non-hygroscopic 1P39 phototube • Balanced armature Sigma sensitive relay.

PROTECTION — From surges and lightning, by linen-based bakelite sub-mounting chassis and proper component spacing Circuit and load fuses, and lightning arrestor • Fail-safe operation.

ADAPTABILITY — Three basic series and numerous models for all mounting requirements, operating voltages, load capacities and desired contact arrangements.

DEPENDABILITY — Proven by the thousands of F-P controls used by hundreds of utilities, over the past ten years.

Complete specifications and operating data are contained in informative F-P Bulletins, available on request. Or call the Fisher-Pierce sales representative in your area, for point-by-point proof of F-P superiority.

THE FISHER-PIERCE CO., INC.

82 Pearl Street, So. Braintree, Boston 85, Mass.

6 Steps to Effective Public Relations

EEI's managing director, in talk to Canadian Electrical Association, emphasizes importance of chief executive's attitude to public relations

Six steps that are necessary for an effective public relations program were outlined recently by Edwin Vennard, managing director of Edison Electric Institute. He addressed the annual convention of Canadian Electrical Association at Murray Bay, Quebec.

The six steps are:

1. Establishment of the objectives.

2. Analysis of present policies and practices in view of the established objectives, elimination of those not in conformity with new goals, and setting up of new policies for which a need is indicated.

3. Determination and evaluation of public opinion regarding the organization.

4. Development of a plan of action.

5. Selection and training of personnel to administer the program.

6. Periodic review and revision of program.

Indicating that good public relations must be earned, Vennard said, "Public relations is a reflection of the way people think you live." He explained: "First you must live right, and then let people know that you do. When you do those two things, your public relations will be good."

Vennard emphasized the extreme importance of the attitude of management and particularly that of the chief executive. "Recognition and acknowledgement that the character, extent, and effectiveness of public relations are a responsibility of top management" is the fundamental requirement of any sound and workable public relations program, he said.

He explained that the president's "policies and approach to public service inevitably will be reflected by the members of his organization, not only in their contacts with customers, but with each other as well, thereby affecting the entire character of the utility's operation."

Noting the unique close relationship of utilities with the public, the EEI executive declared that the electric industry has a special stake in good public relations. "Public relations considerations appear in practically every aspect of utility operations," he said.

Vennard commented on the need for creating in employees an awareness of the importance of each individual in winning good public relations. He cautioned: "Tact, ingenuity, skill and, above all, perserverance are required to make everyone in the company broaden his outlook. When that is accomplished, a sense of corporate unity of purpose and cooperative action will be achieved, together with awareness of the public relations importance of individual actions."

10,000 View Display of Safety Equipment

More than 10,000 persons recently viewed a special display of Indiana & Michigan Electric Co's safety equipment. The display, held in the lobby of Merchants Trust Co at Muncie, Ind., was the first of a series depicting various items of safety equipment used or made by Muncie's firms.

The equipment display is part of a campaign that the utility has launched to make this year, the company's 50th, its safest year.

George Hays, I&M's distribution superintendent, assisted with the preparation of the display. Joe Clark, commercial representative, designed special lighting for the exhibit.

Tall Towers Solve Tough Problems in 220-kv Line

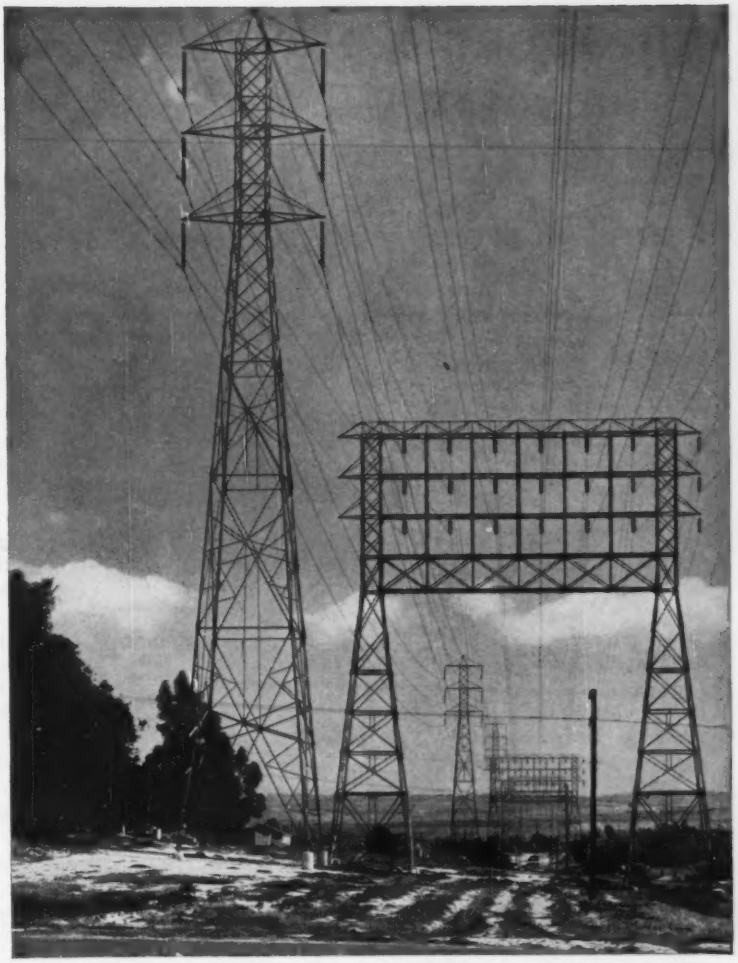
Southern California Edison line uses tall steel towers to overbuild existing lines on narrow right-of-way

Transmission engineers have to be on their toes in Southern California, where tremendous growth in recent years both makes new lines necessary and makes their construction more difficult. The answer lies in creative engineering as illustrated by Southern California Edison Company's recently completed 220-kv line from El Segundo to La Fresa.

NARROW RIGHT-OF-WAY . . . The company's engineers were confronted by the problem of carrying two circuits 7½ miles over the only available right-of-way, a 150-ft strip already occupied by multiple-circuit towers and lines. The solution was to "overbuild" the existing lines with 157-ft-high towers, designed with bases only 24 ft wide. The design was thoroughly tested at Bethlehem's South San Francisco tower shop, where all 46 of the towers for the line were fabricated.

The weight of the towers was just over 10 tons each, except for the heavier anchor towers which weighed nearly 18 tons. They are designed with 36-ft bases. Span length varies from 700 to upwards of 1248 ft. Southern California Edison used an ACSR conductor 1¼ in. in diameter impregnated with grease to combat the highly corrosive atmosphere. It was strung under tension. Only one ground wire was installed.

CONSTRUCTION PROBLEMS . . . Erection of the line required close coordination by the company's operating men and the contractor, Stone & Webster Corporation of Los Angeles. Since most of the existing circuits were vital sources of power, only the two nearest the erection work could be de-energized. Special precautions were put into effect to protect the construction crews.



This photograph shows how little space was available to accommodate the new line (left).

FABRICATED AT SAN FRANCISCO . . . The 46 towers were detailed, fabricated and galvanized at Bethlehem's South San Francisco tower shop.

Other Bethlehem tower shops are located at Seattle, Wash., and Leetsdale, Pa., near Pittsburgh.

If you would like to have further information about the fabrication of transmission towers and substation steel, kindly contact the Bethlehem sales office nearest you.

The new line begins at the El Segundo steam plant, one of Edison's primary power sources. It winds 7½ miles through densely populated areas to the La Fresa substation in the growing Torrance industrial community.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Bethlehem Pacific Coast Steel Corporation, San Francisco.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

European Relays: The Outlook Differs

PEA's Relay and Equipment Committees hear how Europeans depart from U. S. practices. Fast grounding switch, Shippingport reactor described

Basic principles of U. S. and European relaying practices are the same. Differences in execution may be traced to differences in outlook. The large internal market in the U. S. and the small number of manufacturers has fostered a high degree of standardization. In Europe, the demand for economy and flexibility sometimes achieves simpler and perhaps more reliable protection but usually requires more engineering.

Those were the observations made by A. R. Van C. Warrington, English Electric Co, Ltd., at a joint meeting of the Pennsylvania Electric Association's Electrical Equipment Committee and Relay Committee held recently at Pittsburgh.

In the U. S., he said, the induction disc is standard for protective relays with time delay, and the induction cup or balanced beam for high speed. In Europe there is considerable variation; induction devices are most popular, but moving coil relays with rectifiers are used often.

Much Cable Used Abroad

As in the U. S., individual relay cases are popular in England and Sweden. Separate cases are better for standardization and flexibility. In the rest of Europe the tendency is to group all units of a protective scheme in one large case, mounting units on a hinged frame for accessibility. Advantages claimed are lower cost, less external wiring, and easier testing.

Small European countries use cables extensively, Warrington observed. High-speed relays offer no benefit for cable and may even make faults difficult to find. Automatic reclosing for overhead lines is not nearly as common as in the U. S., he said, but is becoming popular with three-shot reclosing below 33 kv and one-shot reclosing for 33 kv and above.

Pilot differential relays are popular in England because of short lines, but are rarely used in other countries which favor distance relays, Warrington continued. Phase comparison carrier is used in England for important lines, and distance carrier is not used at all. Germany has little or no carrier, and France and Switzerland use the distance type. Switzerland has shown some preference for transfer tripping rather than blocking.

English utilities prefer separate distance relays for each phase, Warrington noted, but continental European companies use a smaller, cheaper relay in which single-ohm unit is switched to the appropriate phase voltage and current. This is gaining favor in England now because almost all systems below 66 kv are impedance grounded, requiring distance relays for all ground faults as well as phase faults.

5-Cycle Grounding Switch

The application of automatic grounding switches was described by J. A. G. Oewel, Pennsylvania Power & Light Co, who pointed out that $60,000 to $110,000 can be saved whenever an oil circuit breaker is eliminated at the end of a 132 or 220-kv line. Breaker protection is provided on the low side of the tranformers which are protected by a reliable, fast-acting grounding switch on the high side. Closure of this switch trips a breaker many miles away. Successful development of a switch for this purpose would enable a utility to avoid pilot relay and carrier current channels.

A switch has been developed for this application, said C. W. Upton, Westinghouse Electric Corp. It consists of a blade in a porcelain weather casing filled to 30 psig with sulphur hexafluoride gas. It will close 20,000 amps in 5 cycles and stand repetitive operations.

Shippingport Reactor

E. M. Gue reported on the electrical characteristics of Duquesne Light Co's atomic power station at Shippingport, Pa. Duquesne hopes to get the plant in operation by the end of 1956. The reactor is expected to be inherently stable because of a negative temperature coefficient which slows the reaction as the reactor gets hot. This is part of the control system, but rods also will be used. The reacter heat exchangers and all parts of the primary water system will be enclosed in a steel container to confine radioactivity should something go wrong.

Four 2.4-kv station auxiliary bus sections have been created for the sake of reliability, Gue said. Automatic transfer is provided for this 10,000-kva load. The ultimate objective is transferring the entire load without losing the plant.

Startup and shutdown time will run about 3½ hr, Gue said, and the response of the turbine to load changes will be about the same as for a modern high-pressure unit.

Gue has been promoted to chairman of the Electric Equipment Committee following W. B. Morton's resignation. P. H. Robbins, Metropolitan Edison Co, was named vice-chairman.

What the Delegates Wanted to Know

Warrington's paper stimulated discussion among those attending. Here are a few questions and answers:

Q—We're spending twice as much on relays as Europe. Do we get our money's worth in performance?

A—European relays are simpler but require more engineering. Total cost will be about the same.

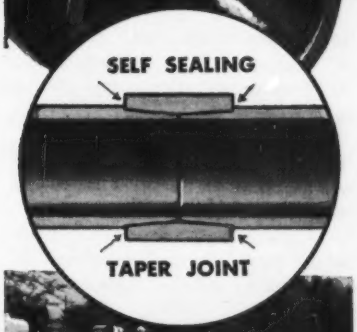
Q—Has there been a tendency in England to eliminate substation breakers wherever possible, as there has been here in the United States?

A—The same tendency appears in England. But it has been said, "You pay for that breaker whether you use it or not."

Q—Is there any trend toward a standardized relay in Europe?

A—There is a hardening of opinion in England that one amp will be the standard relay. This would make all coils in the relay the same type and would permit the use of smaller wire.

SMOOTH BORE!



Orangeburg Fibre Conduit Prolongs Cable Life

Protect cable sheath from abrasion and you prolong the life of underground cables, say utility engineers. Scoring of cable sheath creates "trouble spots" that shorten cable life.

That's where Orangeburg Fibre Conduit plays an important part in keeping cables healthy. Orangeburg's smooth bore, its low coefficient of friction minimize the danger of abrasion when cables are pulled in, as well as later on during cable movement. By protecting cable sheath from abrasion, Orangeburg Fibre Conduit adds years to cable life.

Orangeburg's impermeable wall and watertight joints protect cables from corrosive ground waters. Its nonmetallic material is strong, tough, resilient, long lasting.

And, remember, Orangeburg lays faster and at lower cost than other types of conduit. It is light in weight, easy to handle, easy to tool on the job. Spacers, bends, fittings, 5° bend sections and lightweight tapering tool, all combine to simplify installation.

Since 1893, records of long life have proved Orangeburg's durability and economy.

Orangeburg Fibre Conduit is distributed by Graybar Electric Company and General Electric Supply Company with branches and stocks in principal cities.

WRITE DEPT. EW-76 FOR NEW CATALOG 52.

ORANGEBURG MANUFACTURING CO., INC., Orangeburg, N. Y. West Coast Plant, Newark, Calif.

ORANGEBURG®
FIBRE CONDUIT

Trends in State Utility Regulation

The following developments affecting public utilities have been reported so far from state capitals in 1956:

Arizona—A proposal to abolish the present State Corporation Commission and authorize appointment of commissioners by the Governor was not enacted . . . A proposal to tax each wood pole 5¢ and each steel tower 25¢ was also not enacted.

Among the judicial action was the Arizona Supreme Court which held that the Corporation Commission could, for rate-making purposes, determine the fair value of the utility so long as the commission's action is not "capricious" or without basis.

Handed down in a case, involving a rate reduction ordered for the Round Valley Light & Power Co, the unanimous decision held that the courts have only the power of review of the commission's action and cannot change the rate base set by the commission.

The opinion added, however, that the courts can order the commission to reconsider a previous rate-making action if they find the commission erred in its original findings.

Colorado—State Public Utilities Commission declined to give an immediate ruling on a question of whether a rural electrification association is a public utility subject to regulation as to rates and area.

Indiana—Chairman Warren Buchanan of the state Public Service Commission announced it is likely a bill will be introduced in the 1957 Indiana legislature to tighten the state utility regulatory law and force utilities to limit their evidence in court appeals in rate cases to that they presented before the commission.

Iowa—Director Clayton Ringgenberg of the state Legislative Research Bureau was requested to study the extent of public utility regulation in other states as the basis for possible future Iowa legislative proposals.

The 1955 Iowa legislature defeated a bill proposing creation of a new State Public Utilities Commission, empowered to regulate power and gas companies. Telephone companies, rural electric cooperatives and municipally owned utilities would have been exempt from that proposal.

Kentucky—Vetoed by Governor Chandler was a bill that would have broadened the scope of the state's courts in reviewing the actions of administrative agencies.

The rejected bill would have provided that the State Court of Appeals and Circuit Courts, in review administrative orders, would examine findings of fact upon which the orders were based to determine whether they were supported by substantial evidence in the record when considered as a whole.

Louisiana—A proposal, backed by the Louisiana Municipal Association, would permit cities to impose a local 4% gross receipts tax on public utilities, including telephones.

Introduced under other sponsorship was a bill to repeal the 2% state tax on the generation and sale of electricity.

Massachusetts—Continuance of study of the feasibility of putting electric and telephone utility lines underground was authorized by a measure approved by the legislature.

Also defeated was a bill proposing the establishment of a state power authority, empowered to issue revenue bonds and take private property by eminent domain.

Other unsuccessful legislative proposals would have: Required Court action before utilities could disconnect customers for nonpayment of bills; required state legislative approval of utility rate increases granted by the State Department of Public Utilities; and provided for a legislative investigation of telephone rates in the state.

Mississippi—Legislature enacted a bill revising Mississippi's public utility regulatory law and bringing electric and natural gas utilities under control of the State Public Service Commission.

The measure also provided for a change from the fixing of utility rates on the basis of a fair return on original investment to a fair return on "reproduction costs new" or so-called "fair value" rate base.

Utilities denied rate increases by the PSC will be permitted by the act to put such increases into effect under bond pending the outcome of appeals to the courts.

New Hampshire—Unfavorably reported to the New Hampshire State constitutional convention by its taxation committee was a proposal for an amendment to place electric and gas companies in a special category for tax purposes. It earlier had been strongly opposed at a hearing conducted by the committee.

Purpose of the amendment would be to make it clear that the state could continue to impose a franchise tax on utilities in the event the State Supreme Court should uphold the Public Service Co of New Hampshire in its pending challenge of the constitutionality of the present state franchise levy.

New Jersey—Legislature enacted a bill placing a 7½% ceiling and a 5% floor on the state public utilities gross receipts tax.

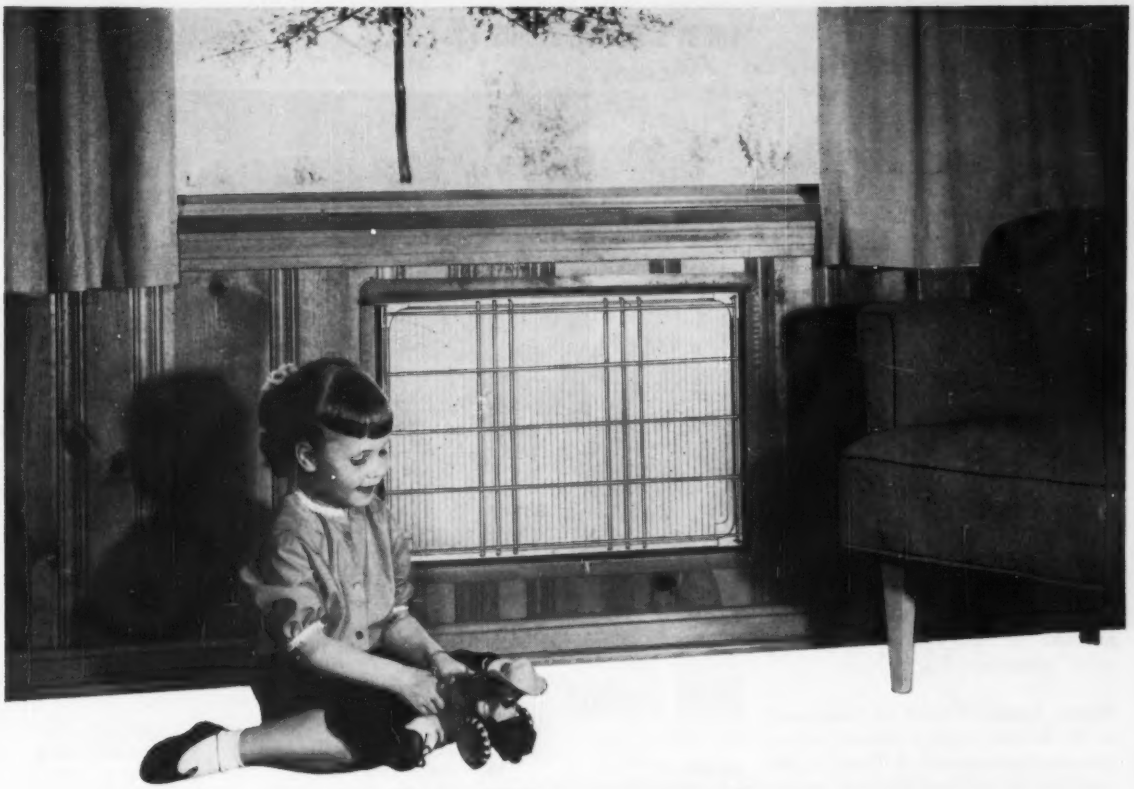
New York—Governor Harriman vetoed a bill that would have restored the practice of sub-metering.

Other enactments included a measure to permit limited investment of state funds in common stock of utility corporations.

Failing of enactment was a bill which would have revised the state public service law to bring rate-fixing regulations covering telephone and railroad companies into line with those applying to gas, electric, water, steam, and omnibus service.

Existing New York law applicable to telephone companies requires the PSC to fix rates with due regard to a reasonable return on "the value of the property actually used in public service." The PSC, in sponsoring the proposed change, noted that this has been interpreted by the State Court of Ap-

(*Continued on page* 180)



Growing fast . . . GLASS PANEL HEATING for good reasons, too!

Nearly everyone likes radiant glass heating once he experiences it. Look what an array of advantages you have to offer . . . to build customer good will.

Radiant heat is comforting. Temperatures within a room vary only 3 to 4 degrees from floor to ceiling. Glass panel heat does not "bake" air to cause irritating dryness, nor does it stir up dust particles, as circulating air heaters often do.

It's safe! The heater plate surface never gets "red hot," doesn't even glow in a darkened room. The high temper glass is tough, resists impact and thermal shock. With adequate wiring, there is no danger of fire or explosion.

Properly insulated homes can be entirely electrically heated. This does away with space-consuming central heating equipment plus ducts, pipes and chimneys. Temperatures in each room can be individually controlled by room thermostats.

Ra-Grid® Heater Plates are time-tested. For over 10 years, Blue Ridge has made the glass, fabricated it into Heater Plates—complete with electric grids. Blue Ridge is the only one that does. Leading manufacturers then use it in their complete heating units. Look for Ra-Grid imprinted on each glass panel.

Electric heating is rapidly expanding . . . well worth backing and promoting. Write for further information and for names of radiant heater manufacturers who use Ra-Grid Heater Plates.

MADE BY **BLUE RIDGE GLASS CORP.**
KINGSPORT, TENNESSEE

BLUE RIDGE GLASS CORP.®

Regulation Trends

(*continued from page* 178)

peals to require consideration of replacement costs of property.

Ohio—Question of whether a building operator can buy electricity at a cheap commercial rate and then resell it at a profit to his tenants was taken under consideration during the spring by the Ohio Public Utilities Commission.

Pointing out the commission has no present policy on reselling current, an attorney-examiner said the policy question might have to be settled by the state legislature.

Although resale for profit is already forbidden by the Columbus & Southern Ohio Electric Co, the rule has not been enforced.

Pennsylvania—None of the bills submitted to the legislature made any mention of the controversial "fair value" determination.

Rhode Island—Failing of enactment in the Rhode Island legislature was a proposal by Governor Roberts for the creation of a position of public counsellor, to represent the ratepayer in public utility rate cases.

Another rejected bill would have given communities the right to operate their own power plants, with referendum approval.

Also killed was a resolution proposing an investigation of Rhode Island gas, electric, telephone, and water rates.

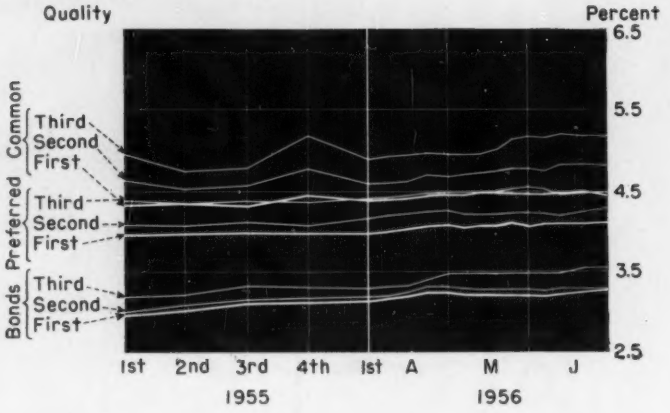
Texas—An opinion handed down recently by the Texas Third Court of Civil Appeals in Austin held that annexation of a rural area already served by a cooperative does not preclude continued service by the cooperative to anyone in the annexed area who wants the service.

The decision said the trial court committed partial error in construing the law as imposing restrictions on co-ops not imposed on commercial companies.

In an opinion written by Chief Justice R. C. Archer, the appellate court said the trial court also erred in concluding the act limited the class of persons eligible to service to persons residing in rural areas.

The interpretation of the state's rural electric cooperative law was given in a suit by the state, South-

Today's Utility Yields (%)



	BONDS			PREFERRED STOCKS			COMMON STOCKS		
QUALITY	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
June 28	3.26	3.28	3.55	4.11	4.29	4.50	4.46	4.81	5.17
June 21	3.25	3.28	3.55	4.10	4.24	4.49	4.51	4.83	5.17
June 14	3.21	3.28	3.48	4.10	4.20	4.48	4.49	4.82	5.18

Utility Earnings

COMPANY	PERIOD MONTHS	ENDED	NET INCOME 1956	NET INCOME 1955	EARNINGS PER COMMON SHARE 1956	EARNINGS PER COMMON SHARE 1955
Alabama Power	12	May	$14,798,648	$13,402,293	$....	$....
Arkansas Power & Light	12	May	5,413,503	7,072,977	....	....
Carolina Power & Light	12	May	9,806,013	8,529,297	1.70(a)	1.57(a)
Central Illinois Light	12	May	4,751,038	3,596,986	4.18(b)	3.10(b)
Central Illinois Public Service	12	May	9,058,862	8,375,108	....	....
Central Maine Power	12	May	6,408,120	6,494,728	1.66	1.69
Central Vermont Public Service	12	May	1,361,333	1,410,036	1.22(b)	1.30(b)
Detroit Edison	12	May	27,209,036	24,239,437	2.43(b)	2.25(b)
Georgia Power	12	May	14,387,647	13,221,615	....	....
Gulf Power	12	May	2,726,820	2,179,665	....	....
Houston Lighting & Power	12	May	15,854,655	13,278,213	2.65	2.21
Iowa Southern Utilities	12	May	1,447,568	1,309,693	1.77(c)	1.59(c)
Kansas City Power & Light	12	May	8,819,741	7,129,883	2.72(g)	2.33(g)
Minnesota Power & Light	12	May	4,351,168	3,631,344	2.20	1.78
Mississippi Power	12	May	2,393,978	2,102,553	....	....
Mississippi Power & Light	12	May	4,300,243	3,936,530	....	....
New York State Electric & Gas	12	May	11,184,381	9,872,720	2.87(h)	2.73(h)
Ohio Edison	12	May	24,258,201	21,625,629	3.70	3.25
Oklahoma Gas & Electric	12	May	8,671,243	7,723,285	2.22(i)	2.17(i)
Portland General Electric	12	May	5,065,714	4,753,107	1.69	1.58
Public Service of New Hampshire	12	May	4,194,665	4,123,809	1.22(j)	1.39(j)
Southern Canada Power	8	May	1,253,861	1,110,762	....	....
Southern Co, consolidated	12	May	28,037,373	24,065,102	1.43(k)	1.33(k)
Southern Indiana Gas & Electric	12	May	2,318,364	2,632,975	1.91(l)	2.43(l)
Tampa Electric	12	May	3,494,896	3,326,288	1.41(m)	1.50(m)
Utah Power & Light and subsidiary	12	May	7,447,180	6,363,353	3.35	3.12
Virginia Electric & Power	12	May	20,148,464	18,145,630	2.67	2.41

Notes—(a) Based on 4,830,000 shares in 1956 and 4,600,000 shares in 1955; (b) Based on average shares; (c) Based on 754,839 shares in 1956 and 747,983 shares in 1955; (g) Based on 2,695,000 shares in 1956 and 2,450,000 shares in 1955; (h) Based on 3,337,475 shares in 1956 and 3,034,068 shares in 1955; (i) Based on 3,283,262 shares in 1956 and 2,984,783 shares in 1955; (j) Based on 2,879,752 shares in 1956 and 2,478,094 shares in 1955; (k) Based on 19,594,946 shares in 1956 and 18,087,643 shares in 1955; (l) Based on 996,363 shares in 1956 and 913,333 shares in 1955; (m) Based on 2,172,855 shares in 1956 and 1,975,323 shares in 1955.

western Gas & Electric Co and a Gilmer taxpayer against Upshur Rural Electric Co-operative Corp and the city of Gilmer. Fifty-four other co-ops joined in the suit because of their interest in the law under which all were organized.

Judge Archer wrote that to hold a rural co-op could not continue to serve an annexed area would be "tantamount to granting Southwestern a monopoly for electric service in Gilmer."

Mass. DPU Gives Go-ahead for Liberalized Write-Off

While no formal order has as yet been issued with respect to the accounting treatment of liberalized depreciation by the Department of Public Utilities of Massachusetts, those companies who are planning to use liberalized depreciation have been instructed that the accounting procedure set forth by the DPU in the order of Dec. 29, 1953, which was the petition of the Boston Edison Co asking for the accounting treatment for the amortization of emergency facilities under Section 124A, should be followed.

In part, this order stated: "During the sixty-months amortization period the company shall include under 'Taxes Assignable to Electric Operations-Account 551' in an account entitled 'Provision for Future Federal Income Taxes' an amount, or amounts, equal to the reduction in federal income taxes resulting from the amortization of emergency facilities and that such amount shall be credited to an account entitled 'Reserve for Deferred Federal Income Taxes' under 'Other Reserves-Account 320.'

"After the said 60-months amortization period, the company shall charge to 'Reserve for Deferred Federal Income Taxes' under 'Other Reserves-Account 320' and shall credit to 'Portion of Current Federal Income Taxes Deferred in Prior Years' under 'Taxes Assignable to Electric Operations-Account 551' an amount, or amounts, equal to the increase in the federal income taxes payable for that year resulting from the fact that normal depreciation cannot be deducted because of the previous amortization of the cost of the facilities pursuant to such necessity certificates."

These Notes were placed privately through the undersigned with an institution purchasing them for investment.

$10,000,000*

ELLIOTT COMPANY

4½% Promissory Notes due 1971

*$8,000,000 has been borrowed by the Company. The balance may be taken up by the Company on the terms and conditions set forth in the Note Purchase Agreement.

F. EBERSTADT & CO.

June 29, 1956

at your fingertips!

. . . a full year's editorial coverage of the electric power industry!

You'll appreciate these attractive, businesslike files to make the year's copies of Electrical World a functional, permanent part of your business or home library. With the indexes bound into the issues twice annually they'll provide instant access to the nearly 8,000 editorial articles published each year. Just three Jesse Jones files, especially designed for Electrical World, protect a year's issues against soil, loss, wear. Copies are instantly removed for use—no wires to fuss with.

Each file is sturdily made (supports 150 lbs.) with red and black Kivar cover (closely resembles leather), lettered in 16k gold. Shipment can be made promptly at the special price of all three files for $7.00, postpaid. And don't forget—SATISFACTION UNCONDITIONALLY GUARANTEED OR YOUR MONEY BACK.

Jesse Jones Box Corp., Dept. EW
PO Box 5120
Philadelphia 41, Penna.

Please send postpaid....Electrical World files, for which I enclose $..... Or please bill me ( ).

Name .....

Address .....

City .....State .....

PROFESSIONAL SERVICES

BARKER & WHEELER

Utility and Industrial Valuations, Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal, Factory Production and Cost Control Systems.

11 Park Place, New York City
36 State Street, Albany, N. Y.

BLACK & VEATCH

Consulting Engineers

Electricity—Water—Sewage—Industry

Reports, Design, Supervision of Construction
Investigations, Valuations and Rates

4706 Broadway — Kansas City 2, Missouri

THEODORE D. BROSS LINE CONSTRUCTION CORP.

Steel Tower & Wood
Transmission Lines
Distribution & Maintenance

175 Enfield St. — Hartford, Conn.

DAY & ZIMMERMANN, INC.

Engineers

Design - Construction - Management
Reports and Valuations

New York — Philadelphia — Chicago

Doble Engineering Company

Electrical Insulation Engineers

Field Testing and Maintenance of High Tension Insulation, Special Problems in Electrical Communications

Office and Laboratory: Doble Park
Box 344, Belmont 78, Mass. (6 miles from Boston)
Branch Office: 20 N. Wacker Dr., Chicago, Ill.

ELECTRICAL TESTING LABORATORIES, INC.

Electrical, mechanical, photometric, radiometric and chemical laboratories, rendering testing, research and associated services, including certification, inspections at factories and field investigations.

2 East End Avenue at 79th St., New York 21, N. Y.

ROBERT E. FOLEY CONSTRUCTION CORPORATION

Construction & Maintenance

Transmission—Distribution—Communication Lines
Substation, Radio and Television Towers

48 Griswold St. — Binghamton, N. Y.

FORD, BACON & DAVIS

Engineers

DESIGN • CONSTRUCTION
VALUATIONS • REPORTS

New York • Chicago • Los Angeles

GILBERT ASSOCIATES, Inc.

Engineers • Consultants • Constructors
Reading, Pa.

Engineering and Design • Construction Supervision
Industrial • Sanitary • Safety
Chemical Laboratory Services
Business and Economic Research
Industrial Relations • Purchasing

New York — Philadelphia — Washington
Rome — Manila — Medellin

HARZA ENGINEERING CO.

Consulting Engineers

Calvin V. Davis — R. Montford Fuelk
Richard D. Harza

Hydroelectric Plants and Dams
Transmission Lines
Flood Control, Irrigation
River Basin Development

400 West Madison Street — Chicago 6

HOOSIER ENGINEERING COMPANY

Erection and Maintenance of
Electrical Transmission and Distribution Lines

1384 Holly Avenue, Columbus, Ohio

JACKSON & MORELAND, INC.

Engineers and Consultants

Design and Supervision of Construction
Reports—Examinations—Appraisals
Machine Design—Technical Publications

Boston — New York

M. W. KELLOGG

Piping System Design Analyses

Unique model tester as well as modern digital computer facilities available for low cost, accurate flexibility analyses of the most complex piping systems.

The M. W. Kellogg Company
711 Third Ave., New York 17, N. Y.

THE KULJIAN CORPORATION

Engineers - Constructors - Consultants

POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)

Utility • Industrial • Chemical

1200 N. Broad St., — Philadelphia 21, Pa.

PETER F. LOFTUS CORPORATION

Design and Consulting Engineers

Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural

First National Bank Building
Pittsburgh 22, Pennsylvania

N. A. LOUGEE & COMPANY

Engineers and Consultants

REPORTS — APPRAISALS
DEPRECIATION STUDIES—RATE CASES
BUSINESS AND ECONOMIC STUDIES

120 Broadway — New York

LUCAS & LUICK

Engineers

DESIGN, CONSTRUCTION, SUPERVISION, OPERATION, MANAGEMENT, APPRAISALS, INVESTIGATIONS, REPORTS, RATES

231 S. LaSalle St., Chicago

THE LUMMUS COMPANY

Engineers and Constructors

385 Madison Ave., New York, N. Y.

Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

CHAS. T. MAIN, INC.

Engineers

Electric, Steam and Hydraulic Projects, Investigations, Reports, Designs and Appraisals

Chamber of Commerce Building
80 Federal St., Boston 10, Mass.

PIONEER SERVICE & ENGINEERING CO.

Consulting and Design Engineers. . Purchasing
Specialists in Financing
Accounting and Other Operations

231 So. La Salle St. — Chicago 4

REIS & CHANDLER, INC.

ADVISORS TO UTILITIES

Financing—Rate of Return

30 Vesey Street, — New York 7, N. Y.

SANDERSON & PORTER CONSTRUCTION

Reports — Surveys

New York — New York

SARGENT & LUNDY

ENGINEERS

140 South Dearborn St.

Chicago, Ill.

F. W. SCHEIDENHELM

Consulting Engineer

Hydraulic Engineering, Hydro-electric Development, Water Supply, Flood Control, Engineering Problems relating to Water Rights and Water Power Law. Appraisals

50 Church Street, — New York 7, N. Y.

SVERDRUP & PARCEL, INC.

Engineers - Architects

Design, Construction Supervision
Steam and Hydro Power Plants
Power Systems - Industrial Plants
Studies - Reports

St. Louis — San Francisco — Washington

F. A. TUCKER, INC.

Contractors—Engineers
specialize in
Distribution - Transmission - Telephone lines - Maintenance - Roads - Bridges Dams

Main Office — 38½ Center Street, Rutland, Vt.
Branch Office — Little Rock Road, Charlotte, N. C.

UTILITIES LINE CONSTRUCTION COMPANY, INC.

Construction and Maintenance

Transmission - Distribution
Electric and Telephone Lines
Consultants

505 York Road — Jenkintown, Pa.

THE J. G. WHITE ENGINEERING CORPORATION

Design • Construction • Reports • Appraisals

80 Broad Street, New York 4

Advertising In This Issue

Acker Drill Co. Inc. 167
Aerotec Corp., The 142
Allis-Chalmers Mfg. Co. ..2nd cover
23, 24, 114, 115, 125, 137, 138
139, 140, 159
Anaconda Wire & Cable Co. .150, 151

Baldwin-Lima-Hamilton Corp. . 11
Baltimore & Ohio Railroad 39
Baxter & Co., J. H. 55
Bethlehem Steel Co. 175
Blackburn Corp., Jasper 47
Blue Ridge Glass Corp. 179
Brown Co. 122

Central Transformer Corp. 30
Chase Brass & Copper Co. 26
Circle Wire & Cable Corp. 35
Cole Electric Co. 184
Cope, Inc., T. J. 148
Copperweld Steel Co. 58

Diamond Power, Specialty Corp. 141
Directory of Engineers 182
Dodge Div., Chrysler Corp. 51
Dossert Mfg. Corp. 54
Dow Corning Corp. 155
du Pont de Nemours & Co., (Inc.)
Elastomers Div. 131

Eberstadt & Co., F. 181
Electric Controller & Mfg. Co.
Div. Square D. Co. ..41, 42, 43, 44
Electric Service Mfg. Co. 17
Electrical Engineers Equipment
Co. 143
Electrical World 52, 53
Electroline Company 5
Electromode Corp. 146
Elliott Company 37
Engineers, Directory of 182
Enjay Company Inc. 129
Erico Products Inc. 136
Everstick Anchor Co. 128

Federal Pacific Electric Co.
3rd cover
Ferranti Ltd. 123
Fisher-Pierce Co., Inc. 173
Foster Wheeler Corp. 48, 49

General Cable Corp. 40
General Electric Co.
Apparatus Dept. .97, 98, 99, 100, 102
103, 104, 105, 108, 109, 110, 111, 166

Hazard Insulated Wire Works. 4
Homelite Div. Textron, Inc. 147
Hubbard & Company 155
Hubbell, Inc., Harvey 31

I-T-E Circuit Breaker Co.
Switchgear Div. 10
Indiana Steel & Wire Co., Inc. . 121

Johns-Manville 166
Jones Box Corp., Jesse 181

Kaiser Aluminum & Chemical
Sales Inc. 12, 13
Kearney Corp., James R. 56, 57
Kellogg Co., The M. W. 45
Kidde & Co., Inc., Walter 32
Kimble Glass Co., Sub.
Owens-Illinois 46
Knopp, Inc. 169
Kuhlman Electric Co. .....4th cover

Lapp Insulator Co., Inc. 28, 29
Leach Corp., Inet-Palmer Div. . 34
Leeds & Northrup Co. 133

Malleable Iron Fittings Co. 153
Mallory & Co., Inc. P. R. 6
Minerallac Electric Co. 169
Minnesota Mining & Mfg. Co. .. 145
Mitts & Merrill 154
Moloney Electric Co. .61, 62, 63, 64
Monsanto Chemical Co. 135

National Electric Coil Co. 149
Natvar Corp. 127

Ohio Brass Co. 117, 118, 119, 120
Okonite Co., The 4
Orangeburg Mfg. Co., Inc. 177
Overton Co., S. E. 169

PLM Products, Inc. 159
Page Fence Ass'n. 154
Page Steel & Wire Div.,
American Chain & Cable 158
Pennsylvania Transformer Co. 7, 27
Phelps Dodge Copper Products
Corp. 38
Preformed Line Products Co. .. 16
Premax Products Div.,
Chisholm-Ryder Co., Inc. 168

RT&E Corp. 134
Reliable Electric Co. 33
Revere Copper & Brass, Inc. 113
Roebling's Sons Corp., John A. .. 50
Royal Electric Mfg. Co., Inc. 144
Ryerson & Son Inc., Joseph T. . 168

S&C Electric Co. 18
Sangamo Electric Co. 59
Searchlight Section 170, 171
Shaw-Perkins 168
Simplex Wire & Cable Co. 9
Socony Mobil Oil Co., Inc. 15
Southern States Equipment
Corp. 8
Square D. Co. Electric Con-
troller Mfg. Co. Div. 41, 42, 43, 44
Standard Transformer Co. 36
States Co. 167
Sylvania Electric Products, Inc. 152

United States Rubber Co. 25

Western Precipitation Corp. 157
Westinghouse Electric Corp. 14
160, 161
Willys Motors Inc. 60

■

PROFESSIONAL SERVICES 182

■

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES. 170, 171

EQUIPMENT
(Used or Surplus New)
For Sale 171

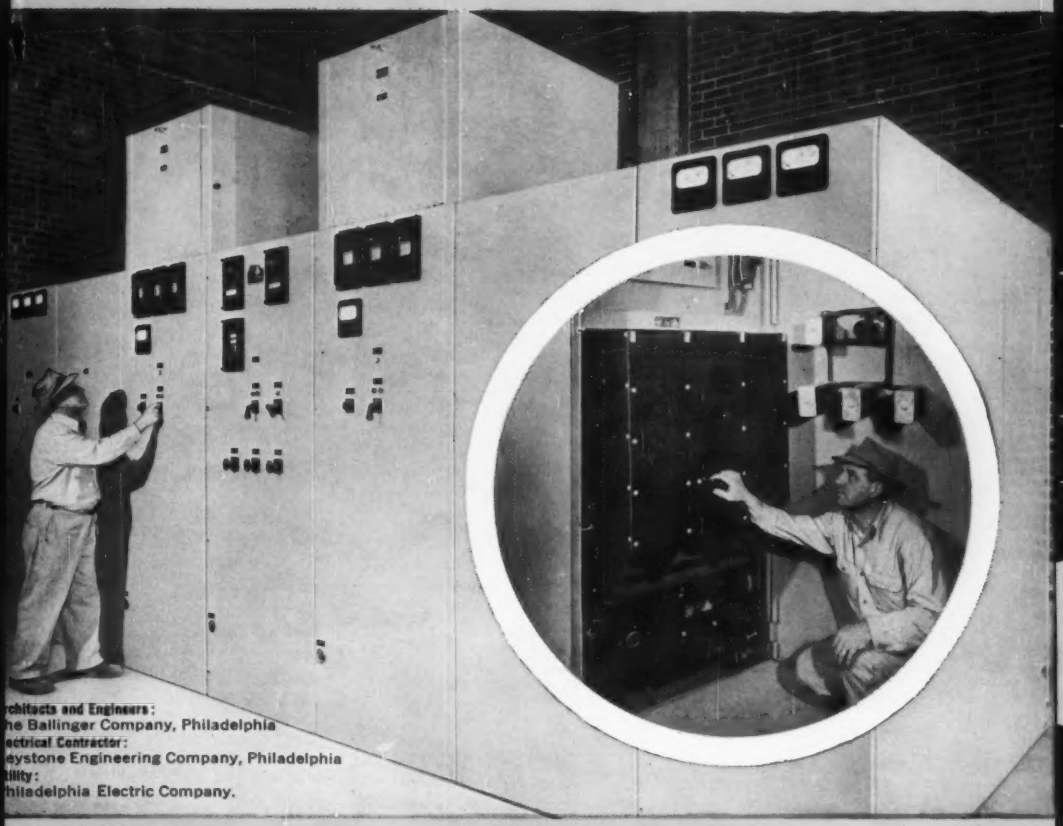
Cole Electric Co.

8439 Steller Drive TExas 0-4701 Culver City, Calif.

AIR BREAK DISCONNECTING SWITCH
115,000 volts — 1200 amperes
Type 0-2
Underhung mounting. Three-pole, single throw.
Group operated. One pole shown.
Silver to silver contacts.

FEDERAL PACIFIC SWITCHGEAR

FOR ULTRA-MODERN SCHOOL ELECTRICAL SYSTEM



rchitects and Engineers:
he Ballinger Company, Philadelphia
ectrical Contractor:
eystone Engineering Company, Philadelphia
ility:
hiladelphia Electric Company.

STRESSING SAFETY!
CONTINUITY OF SERVICE!
MINIMUM MAINTENANCE!

The Philadelphia Board of Education wanted to have the finest electrical distribution system available for their new Northeast High School. Their specifications: ample reserve capacity...maximum safety...assured service continuity...and minimum maintenance.

To meet these strict requirements, Federal Pacific furnished 13.2 kv Metal-Clad Switchgear with magnetic air circuit breakers for dual incoming service and tie circuits. Relays and associated equipment provide automatic load transfer in the event of a failure on one of the incoming circuits. Primary distribution from this switchgear supplies Federal Pacific secondary unit substations located at centers of power utilization throughout the building.

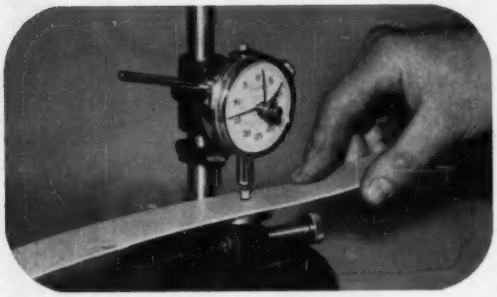
Finest Products Engineered

FEDERAL PACIFIC ELECTRIC
COMPANY
50 Paris Street, Newark 1, N. J.

FPE
FEDERAL PACIFIC ELECTRIC

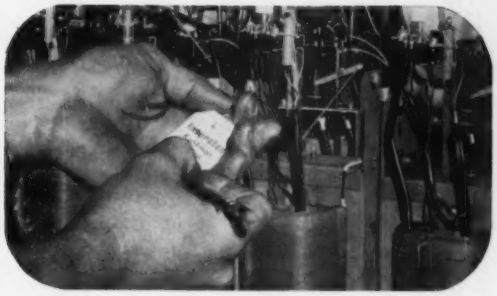
"Here's how every Kuhlman transformer gets 5 thorough quality checks before it's released for shipment..."

G. W. Miller
Supervisor of Quality Control



INCOMING MATERIALS CHECK—first step in maintaining traditional Kuhlman quality. All raw materials are carefully checked, upon arrival, against quality standards and original ordering specifications.

FABRICATION CHECK—many individual quality checks occur during fabrication. Photo shows coil being measured for dimensional accuracy. Tanks and cores receive similar rigid checks.



ASSEMBLY CHECK—as every Kuhlman transformer is assembled, there are scores of checks on clearances, connections and general construction. OK tag must be on every unit before it can be tanked.

LINE CHECK—double checking is required on Kuhlman's production lines. Here, complete and final checks are made of all construction, bushings, adjustments and connections before tank cover goes on.

FINAL CHECK—completing the cycle of 5 quality checks, final inspection is made on paint, gap settings, nameplate, accessories and other specifications. Only then is a Kuhlman transformer OK'd for shipment.

KUHLMAN
ELECTRIC COMPANY

5613

BAY CITY, MICHIGAN • CRYSTAL SPRINGS, MISSISSIPPI • SALINAS, CALIFORNIA